THE EFFECT OF TEAM BUILDING PRACTICES ON SAFETY PERFORMANCE

by

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THESIS

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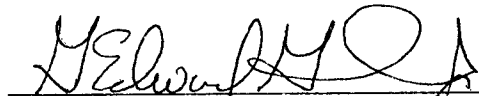

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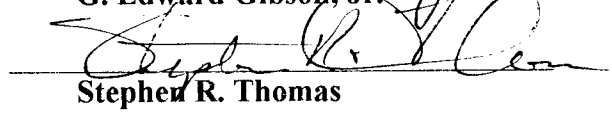

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I have completed my requirements for my Master of Science degree in Civil Engineering at the University of Texas at Austin. Enclosed is a copy of my thesis entitled "The Effect of Team Building Practices on Safety Performance." If you have any questions, you may reach me at the address above.

Sincerely,

Marshall T Sykes

Marshall Troutman Sykes

LT, CEC, USN

Acknowledgements

I would like to acknowledge and thank my wife, Cindy, for the support and encouragement she has given me in this endeavor and in my military career.

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ABSTRACT

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The University of Texas at Austin, 1998

SUPERVISOR: G. EDWARD GIBSON, JR.

Team Building creates a working atmosphere where characteristics are developed that enable the team to be effective. Construction projects that have successful safety programs have many of the same characteristics of effective teams. This thesis analyzes whether team building use affects safety performance for different sized projects. Comparisons are also made of safety practices based on team building use. The analysis is centered on the data collected in the 1996 and 1997 Benchmarking and Metrics surveys that were conducted by the Construction Industry Institute.

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1. Introduction

1.1 PURPOSE.

The use of team building has grown in popularity due to benefits gained in many areas. Team building concepts are being used more and more in today's construction environment. Project teams can be formed to focus on a variety of items in the engineering, procurement, and construction process. The purpose of this thesis is to analyze how the use of team building practices affect safety practices and safety performance on construction projects.

Team building and safety are two "best practices" included in Benchmarking and Metrics Surveys that are conducted annually by the Construction Industry Institute (CII). This analysis looks at completed projects data collected in 1996 and 1997.

CII is an internationally recognized research consortium that was founded in 1983. It is a collaborative effort between construction owners, contractors, and universities to improve the safety, quality, schedule, and cost effectiveness of the capital investment process by working together in a win-win environment (CII 1998).

1.2 SCOPE.

This analysis is centered on the data collected in the 1996 and 1997 Benchmarking and Metrics surveys conducted by CII. After deletion of

projects that did not contain sufficient data for this analysis, there are 113 total contractor projects and 140 owner projects in the database being reviewed. Comparisons are made of how safety performance is affected by team building use, project cost, and craft workhours. Comparisons are also made of safety practices based on team building use.

1.3 RESEARCH OBJECTIVES

The objectives of this research are to:

1. Determine how frequently team building was used for this sample.
2. Compare differences in owners and contractors survey results in team building use versus safety performance.
3. Determine if the team building best practice index score is correlated with the safety index score (composed of safety best practices).
4. Determine the effect of team building on recordable incident rate (RIR).
5. Determine the effect of team building on lost workday case incident rate (LWCIR).
6. Determine the effect of team building on zero recordables.
7. Determine the effect of team building on zero lost workday cases.
8. Compare differences in owner and contractor survey results in team building use versus safety best practices.

1.4 HYPOTHESES

The hypotheses formulated for this study are:

1. The team building use index and the safety best practice use index are correlated.
2. Team building use positively affects RIR.
3. Team building use positively affects LWCIR.
4. Team building use positively affects the number of zero recordables.
5. Team building use positively affects the number of zero lost workday cases.
6. Team building use leads to more use of safety best practices.

1.5 ORGANIZATION

This report is organized into six chapters. Chapter 2 contains the background of team building and safety in the construction industry. Chapter 3 describes the methodology for data gathering and analysis. Chapter 4 presents the data collected and the data analysis. Chapter 5 presents conclusions from the study. Chapter 6 provides recommendations for actions and future research.

2. Background

2.1 TEAM BUILDING AND SAFETY BEST PRACTICES

Team building and safety are two of the construction industry best practices identified by CII. Some of the other best practices are constructability, pre-project planning, design/information technology, project change management, strategic alliances, and percent design complete (CII 1997). It is recognized in the construction industry that best practices normally work together to bring about effective project performance. That is, one particular best practice does not necessarily work by itself to bring about desired results on a project. However, one best practice that can usually affect all others is team building. Team building is effective because it employs the collective synergy of the team members which is normally more effective than the sum of each individual working separately.

2.2 TEAM BUILDING TERMS

CII defines team building as (Albanese 1993):

> a project-focused process that builds and develops shared goals, interdependence, trust and commitment, and accountability among team members and that seeks to improve team members' problem-solving skills.

The team building process is normally focused on a particular project and is short-term. It brings together key stakeholders involved in the project

and "seeks to resolve differences, remove roadblocks and proactively build and develop the group into an aligned, focused and motivated work team that strives for a common mission and for shared goals, objectives, and priorities" (CII 1993a).

Some of the characteristics of effective teams include trust, commitment to working together, shared goals, open communication, competent leadership, selection of qualified members, ensuring accountability, and clarification of assignments. The team building process creates a working atmosphere where these characteristics are developed enabling the team to be effective.

Partnering is a variation of team building. CII defines partnering as "a long-term commitment between two or more organizations" (Albanese 1993). This long-term commitment is normally a contractual agreement between the partnering organizations to work together on a series of projects.

Team management principles outlined in Figure 1 are often used during facilitation of team meetings to get all parties to operate in the partnering mode (Mosley 1991). Operating in the partnering mode should be the desired goal of all team members. Partnering produces win-win project solutions where the stakeholders focus on the issues at hand and on team relationships.

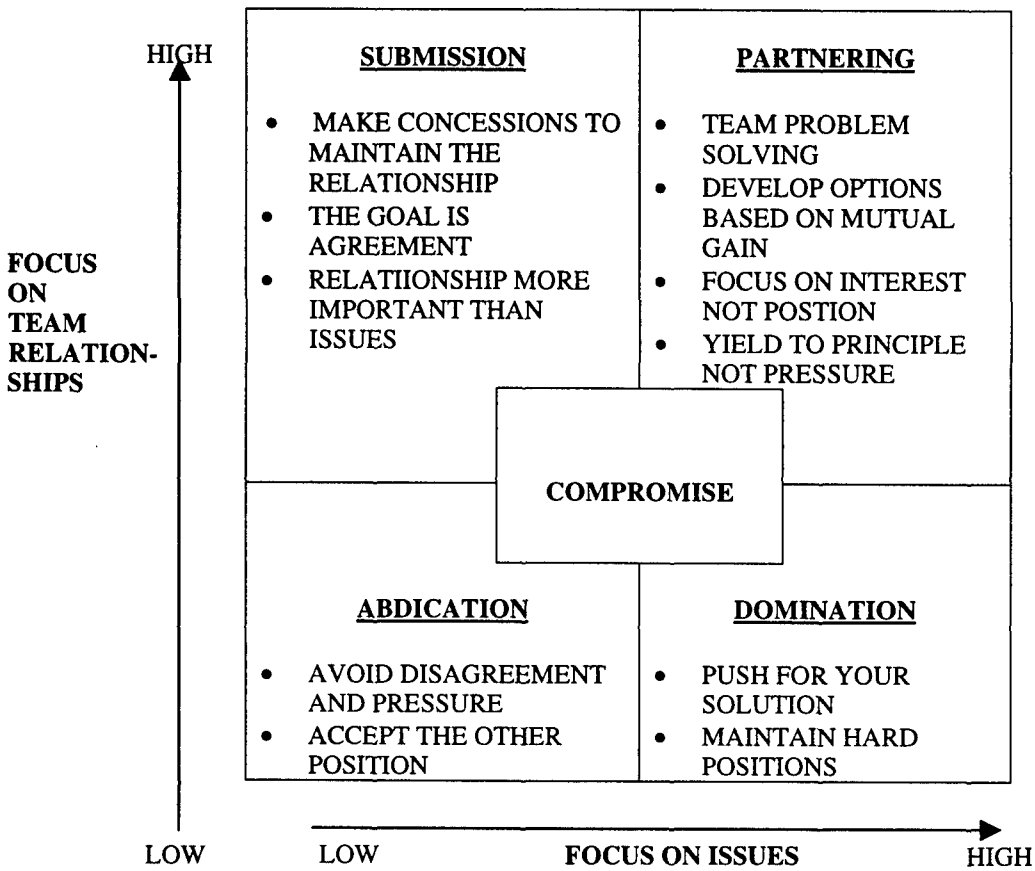


Figure 1: Team Management Styles Matrix.

2.3 Costs/Benefits of Team Building and Safety

Almost every construction project has many parties involved in the construction process which requires a great deal of leadership effort in getting the goals of the various parties aligned on a particular set of objectives for the

entire project. Team building helps set the objectives and keep them intact during the construction process.

The use of team building is recognized in the construction industry as an excellent tool to employ in overcoming adversarial relationships among the various parties involved. It enables project stakeholders to be aligned and avoid unfocused, non-agreed upon goals that could have detrimental impacts on the project. These impacts can greatly increase project costs.

An item that will contribute to an increase in construction costs is a poor safety program. Poor safety records lead to increases in insurance premiums which in turn lead to increases in construction project costs. Contractors with poor safety records pay approximately twice the amount of insurance premiums of those with good safety records. In the United States, the construction industry accounts for 20 percent of traumatic occupational injuries and 12 percent of disabling injuries, but only represents 5 percent of the nation's employed workforce (Liska 1993).

Construction projects that have successful safety programs were found to also have management commitment, hazard control, safety training and meetings, employee support, safety inspections, internal communications, accident investigation procedures and record keeping, emergency procedures and services, and a safety coordinator (Liska 1993). Many of these items go hand in hand with the type of objectives that effective teams focus on.

Given that costs of construction projects can already be high, owners can look to team building as a way to eliminate or reduce the impacts caused by adversarial relationships that can make costs even higher. Adverse contractual relationships between owners, prime contractors, and subcontractors are normal occurrences on projects constructed with firm fixed-price contracts (Hinze and Talley 1988). However, without the existence of adversarial relationships, reductions of 10-30 percent in project costs can be realized (Albanese 1993).

Costs for team building are quite small when compared to this potential reduction in costs. However, a CII study on team building practices on 41 construction projects indicates that savings due to the use of team building are not always quantified. In fact, most construction personnel surveyed had a great deal of difficulty in trying to quantify costs for team building and the benefit savings associated with its use. They can point out the improvements to the project with the use of team building but normally do not attempt to quantify those improvements (Albanese 1993).

Team building not only reduces costs on most projects, it also improves project quality, reduces schedule length, reduces rework, leads to quicker identification and resolution of problems, improves project safety, and lowers change order rates (Albanese 1993). Considering all of the benefits of team building, the costs associated with it can be viewed as an investment for a higher quality, lower cost project that is completed earlier

than scheduled. Thus, team building costs can easily be justified as a project expense.

Team building costs are not extensive. They include the members time, training sessions, recognition items (such as hats, buttons, etc.), and fees for consultants/facilitators. Together, these are insignificant compared to the benefits of team building, and thus, the costs are easily absorbed into the project cost. Normally, team building costs are shared among the participating organizations. This helps reinforce the team concept and ensures a level of commitment to team building from the different organizations involved.

Besides reductions in adversarial relationships and project costs, team building creates a win-win situation between owners and contractors. This is achieved by establishing an environment of trust, improved cooperation and cohesiveness, open communication, problem solving, removal of barriers, and aligned goals. This environment allows the project team to create a shared commitment among members to work together and allows the project execution to flow more easily.

Normally, a successful team includes workers familiar with the tasks at hand. Without the workers input in solving complex issues, management can only guess at solutions. Morrison Knudsen, a construction contractor, found this out on a long-term construction project in which management attempted many times to resolve injury rate fluctuations but could not. After creating a worker construction safety team to look into this problem,

Morrison Knudsen's safety performance improved. This team building process emphasized management commitment, open communication, shared goals, and mutual trust (Findley and Timmons 1995).

Effective project planning requires the use of good team building skills and is an outcome of the team building process. Studies have proven that good safety practices improve with effective project planning. This planning effort requires time and money up front but the benefits in safety performance improves the overall productivity of the project, reduces project costs, and enhances the ability to maintain the schedule (Veteto 1994).

2.4 BENCHMARKS

Although, it is difficult to quantify the benefits of team building on a single project, CII established a research team to develop a set of metrics to assess the benefits of partnering and to determine partnering benchmarks. The research team has identified some top performers in the use of partnering and team building in the construction industry as shown in Table 1. This table points out that it is possible to improve safety performance with the use of team building practices (CII 1996b).

Partnering on NAVFAC projects was documented in a 1995 study. As compared to non-partnered NAVFAC projects, the study shows that partnering reduces the occurrence of claims from 18 to 7.5 percent, increases value engineering savings from 4 to 17.5 percent, and reduces schedule growth from 26 to 13.5 percent. However, it shows no effect on cost changes

and change order costs. In addition, safety improvements due to partnering were not reviewed in this study (Schmader 1995).

Table 1: Top Performers - Partnering vs. Traditional Construction (CII 1996b).

Category	Result Area	Results
Cost	Total Project Cost (TPC)	10% reduction
	Construction Administration	24% reduction
	Marketing	50% reduction
	Engineering	$10 per hour reduction
	Value Engineering	337% increase
	Claims (% of TPC)	87% reduction
	Profitability	25% increase
Schedule	Overall Project	20% reduction
	Schedule Changes	48% reduction
	Schedule Compliance	Increased from 85% to 100%
Safety	Hours without lost time accidents	2 million vs. 48,000 industry standard
	Lost work days	4 vs. 6.8 industry standard
	No. of Doctor cases	74% reduction
	Safety rating	5% of national average
Quality	Rework	50% reduction
	Change orders	80% reduction
	Direct work rate	42% reduction
Claims	Number of claims	83% reduction
	Projects with claims	68% reduction
Other	Job satisfaction	30% improvement

2.5 SAFETY INJURY COSTS

Table 2 provides cost information on safety injuries (Hinze and Applegate 1991). It indicates that each lost workday costs an employer

$25,000. This is a significant figure and can be detrimental to a project's cost if the LWCIR is high. An effective safety program can reduce the LWCIR and is less costly than medical and insurance bills.

Table 2: Safety Costs.

Type of Injury	Direct Job Costs	Indirect Job Costs	Estimated Liability Costs	Total Cost to Employer
Medical Only	$520	$440	$240	$1,200
Lost Workdays	$6,900	$1,600	$16,500	$25,000

A study that reviewed lost workday cases and recordable incidents for the period of 1989 to 1996 showed that CII member companies have a lower LWCIR and a lower RIR than the United States construction industry as a whole (Stone 1998). The information from this study and from Table 1 indicates that projects that use team building may experience a lower LWCIR and a RIR than those projects that do not use team building. This possibility is discussed further in the next couple of chapters.

3. Research Methodology

3.1 Data Collection

The data used for this analysis was obtained from the 1996 and 1997 Benchmarking and Metrics (BM&M) database survey results that were gathered by CII. CII performs an annual survey of its membership requesting information from both owners and contractors. Sixty percent of the database projects are heavy industrial with the remainder being light industrial, infrastructure, and buildings. The data collection procedures are outlined in the 1996 and 1997 survey reports. (CII 1996a and CII 1997). The 1997 survey results contain a few foreign projects but these are not included in this analysis.

The survey results are collected by two questionnaires - one for owners and one for contractors. For the most part, the survey questions are the same for both owners and contractors. However, there are some slight variations and thus the need for separate questionnaires for the two groups. See Appendix A for the 1997 owners survey questionnaire, and see Appendix B for the 1997 contractors survey questionnaire.

The 1997 survey was expanded from the previous year to include additional questions. CII included questions for four best practices in its 1996 survey and for eight best practices in its 1997 survey. Team building and safety were included in both of the surveys.

3.2 DATA PREPARATION

The survey results for 1996 and 1997 were combined in a Microsoft Excel™ spreadsheet for this analysis. The information contained in the owner and contractor databases is extensive. There are 190 total projects in the owner database and 206 total projects in the contractor database. To prepare the data for analysis, some data elements were removed from consideration. These items included:

1. Survey question #18a concerning overtime craft workhours was eliminated from consideration because the 1996 database does not include this question.
2. In the contractor database, the data in question #18 on craft workhours, recordable injuries, and lost workday cases were combined for contractors and subcontractors for comparison purposes since the owner database did not separate them by contractor and subcontractor.
3. Questions 27-34 pertain to safety practices and were answered in one of the following ways: "regularly", "sometimes", "seldom", or "never". For these categories, "regularly", "sometimes", and "seldom" were taken as "yes" and "never" was taken as "no". (Note that, "seldom" was given as an answer approximately 1 percent of the time.)

Additionally, projects that did not contain complete information were deleted from the analysis. The following items explain this further:

1. All foreign projects were eliminated from the analysis except for Canadian projects.
2. Projects that contained incomplete safety information were deleted from the analysis. For example, many of the contractor projects did not report any data on workhours, recordable incidents, and lost workday cases (question 18). Sixteen of the 115 projects in the 1996 database and 25 of the 91 projects in the 1997 database did not report these figures. Because of this, the number of projects that could be analyzed in this study was significantly reduced.
3. This analysis only reviews safety during the *construction phase* of the projects. Survey results for other phases such as design only, pre-project planning, etc., are not included in the analysis since they did not have direct impact on construction safety practices.

After these sample projects were deleted, 140 of the original 190 owner projects and 113 of the original 206 contractor projects remained for this analysis.

3.3 ANALYSIS METHODS

CII has generated an index metric for each of the eight construction best practices. An example of the index score is shown in Appendix C for team building use and in Appendix D for safety practice. Basically, each question in the survey that pertains to that particular best practice is included in the index and is scored between 0 and 1. The highest score possible on each index is 10. If all practice elements are used to their fullest extent, an index score of 10 is achieved (CII 1997). The index scores for each project were obtained from CII for use in this study.

For null hypothesis #1 (H_0 #1: The team building use index score correlates with the safety index score), the team building use index was compared against the safety practice index.

In addition to the team building index relationships, projects were separated by team building use or non-use and compared against each other for hypotheses #2-6. Comparisons were made separately for owners and contractors.

Team building use is based on the "yes/no" answer to survey question #35, "Was a team building process used for this project?" If the survey respondent answered "yes" to the question, the rest of the team building questions in the survey were answered. If the respondent answered "no" to the question, the rest of the team building questions were not answered (for more information see Appendices A and B). It is possible to use some of the principles of team building without actually identifying the project as one that

is using team building. However, this analysis is based on whether the project was identified as using team building or not in the response to question #35.

The RIR metric is a work-related death or illness and any injury that results in loss of consciousness, restriction of work or motion, transfers to another job, or requires medical treatment beyond first aid (CII 1993b). It is calculated according to the following equation:

$$RIR = \frac{Number\ of\ recordable\ incidents \times 200{,}000\ hours}{Labor\ hours\ worked} \qquad Eq.\ (1)$$

In order to test the null hypothesis for hypothesis #2, the following items were compared by team building use/non-use:

(H_0 #2: Team building use positively affects RIR metrics).

1. RIR scores
2. RIR for all projects in this sample
3. RIR by project cost category
4. RIR by craft workhour category

The LWCIR metric is a workday missed by a worker due to an injury. Safety on construction projects is considered excellent if the LWCIR is less than 1.0 and good if it is 1.0 - 4.4 (Stone 1998). LWCIR is calculated according to the following equation:

$$LWCIR = \frac{Number\ of\ lost\ workday\ cases \times 200{,}000\ hours}{Labor\ hours\ worked} \quad Eq.\ (2)$$

In order to test the null hypothesis for hypothesis #3, the following items were compared by team building use/non-use:

(H_0 #3: Team building use positively affects LWCIR metrics).

1. LWCIR scores
2. LWCIR for all projects in this sample
3. LWCIR by project cost category
4. LWCIR by craft workhour category

In order to test the null hypothesis for hypothesis #4, the following items were compared by team building use/non-use:

(H_0 #4: Team building use positively affects the number of projects with zero recordables).

1. Zero recordables for all projects in this sample
2. Zero recordables by project cost category
3. Zero recordables by craft workhour category

In order to test the null hypothesis for hypothesis #5, the following items were compared by team building use/non-use:

(H_0 #5: Team building use positively affects the number of projects with zero lost workday cases).

1. Zero lost workdays for all projects in this sample
2. Zero lost workdays by project cost category
3. Zero lost workdays by craft workhour category

Zero recordables and zero lost workdays measure if a project had any recordable injuries and any lost workdays, respectively. A project is considered to have an excellent safety program if it has zero accident performance in both of these categories.

In addition to the analysis on safety performance, team building use is compared to safety practices in this study. There are eight safety-related practices that are normally implemented to help achieve excellent project safety performance. They are pre-project/pre-task planning, safety orientation/training, safety incentives, alcohol and substance abuse program, accident and near miss investigation, record keeping and follow-up, safety meetings, and personal protective equipment. The first five of these are identified as safety best practices by CII (Liska 1993). In order to test the null hypothesis for hypothesis #6, the following safety practices were compared by team building use/non-use:

(H_0 #6: Team building use leads to more use of safety best practices).

1. Pre-task planning
2. Employee orientation

3. Employee incentives
4. Pre-hire testing
5. Random testing
6. Testing after accidents
7. Accidents investigated
8. Near misses investigated
9. Senior management review

3.4 STATISTICAL ANALYSIS

For both safety performance and safety practices, statistical analysis is given in each section of discussion. Microsoft Excel™ was used to generate data charts for these analyses. Regression analysis is performed for each index chart with the trendline and R Square (R^2) value given on each chart. R^2 provides an index of the strength of association between the variables analyzed. It "measures the proportion of variation in the dependent variable that is explained using the regression line" (Middleton 1997).

For example, an R^2 value of 0.7342 indicates that a linear model using the independent variable can explain approximately 73 percent of the variation in the dependent variable. The minimum R^2 value is zero, and the maximum is 1.00. Values close to zero indicate very weak models.

Analysis of variance (ANOVA) tests are performed for each sub-sample since there are two sources of variation for the sub-samples analyzed.

ANOVA is used to learn whether there is statistical evidence that groups differ on some dependent variable.

P-values are used to judge the statistical significance of F-tests; the smaller the obtained p-value, the less likely data analyzed came from a population in which the null hypothesis (of no group differences) is true. For example, a p-value of 0.04 indicates that data like that obtained in the sample would occur 4 times out of 100 if in fact the null hypothesis is true, i.e., the groups are not actually different on the dependent variable. Normally, p-values are judged against an alpha level or 0.05, and this is the level that will be used in this study. However, alpha levels of 0.10 are used occasionally in data analysis (Blank 1980).

4. Data Presentation and Analysis

4.1 Data Presentation

As discussed previously, CII's Benchmarking and Metrics Survey results document owner and contractor projects. The owner project data used in this study are contained in Appendix E, and the contractor project data are given in Appendix F. The project index score data for both owners and contractors are contained in Appendices G and H, respectively. Only information pertinent to this analysis is included in these appendices.

Table 3 shows the number of projects for each category type used in the analysis. Some of these have low numbers, which makes comparisons to other categories difficult to analyze as discussed previously. This table shows that owner projects reported a higher use of team building than contractor projects did. It also shows that the use of team building generally increases, particularly for owner projects, as the project cost increases and as the number of craft workhours increases.

Table 3: Number of Projects in each Category Type.

	No. of Owner Projects		No. of Contractor Projects	
Category	**Team Building Used**	**Team Building Not Used**	**Team Building Used**	**Team Building Not Used**
All Projects	108	32	67	46
Project Cost				
< $15 M	44	16	16	18
$15 - $50 M	31	10	21	13
$50-$100 M	18	5	14	9
> $100 M	15	1	16	6
Craft Workhours				
< 100K hours	33	17	10	12
100K - 250K hrs.	31	7	15	7
250K - 500K hrs.	19	5	14	10
> 500K hrs.	25	3	28	17

4.2 TEAM BUILDING USE ON ALL PROJECTS

Figure 2 shows the percentages of projects for owners and contractors that used team building. The chart shows that owner projects are more likely to use team building than contractor projects. Seventy-seven percent of owner projects used team building whereas only 59 percent of contractor projects used it.

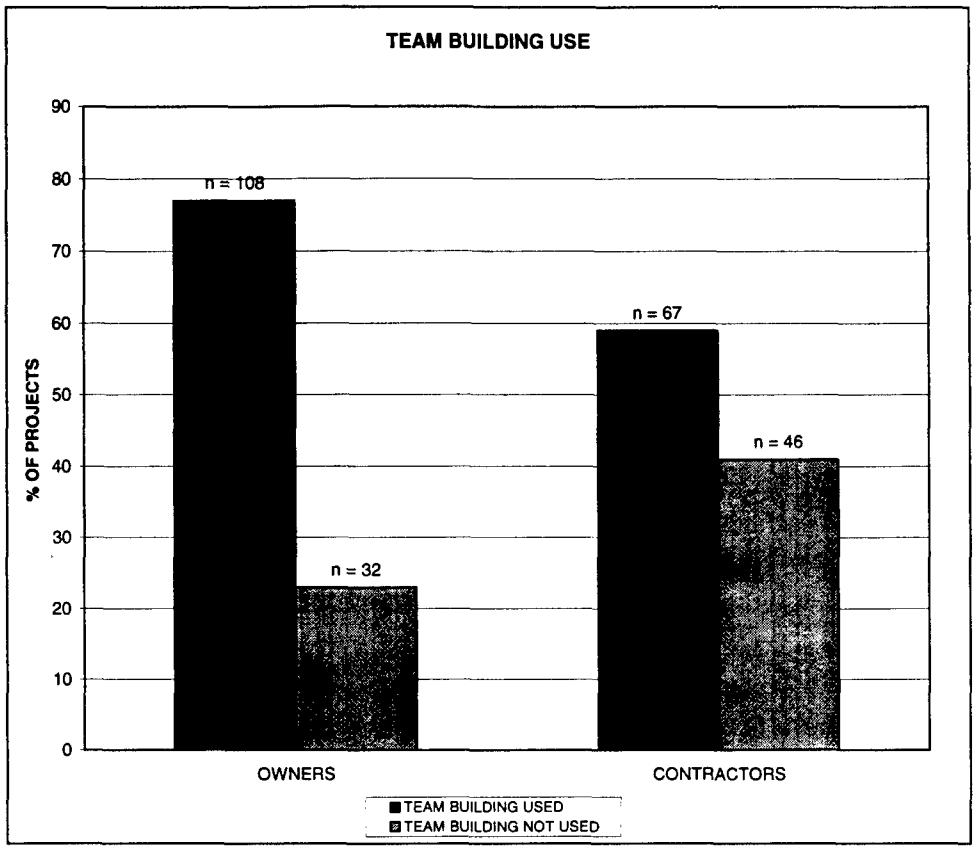


Figure 2: Team Building Use - All Projects, Owners and Contractors.

One of the objectives of this analysis is to determine the effect of team building use on safety practice as determined by the index scores of these two best practices. H_0 #1 (the team building use index and the safety best practice use index are correlated) appears to be confirmed in Figures 3 and 4 as their trendlines show an increase in the safety practice index as the team building index increases. However, this relationship is weak as indicated by R^2 values of 0.05 and 0.08 for Figures 3 and 4, respectively.

The significance of F values for these two figures are statistically significant. The significance of F values are 0.002 and 0.000 indicating that the there is a 99.8 percent and a 100 percent chance, respectively, that the results (weak relationships in the index scores) are correct.

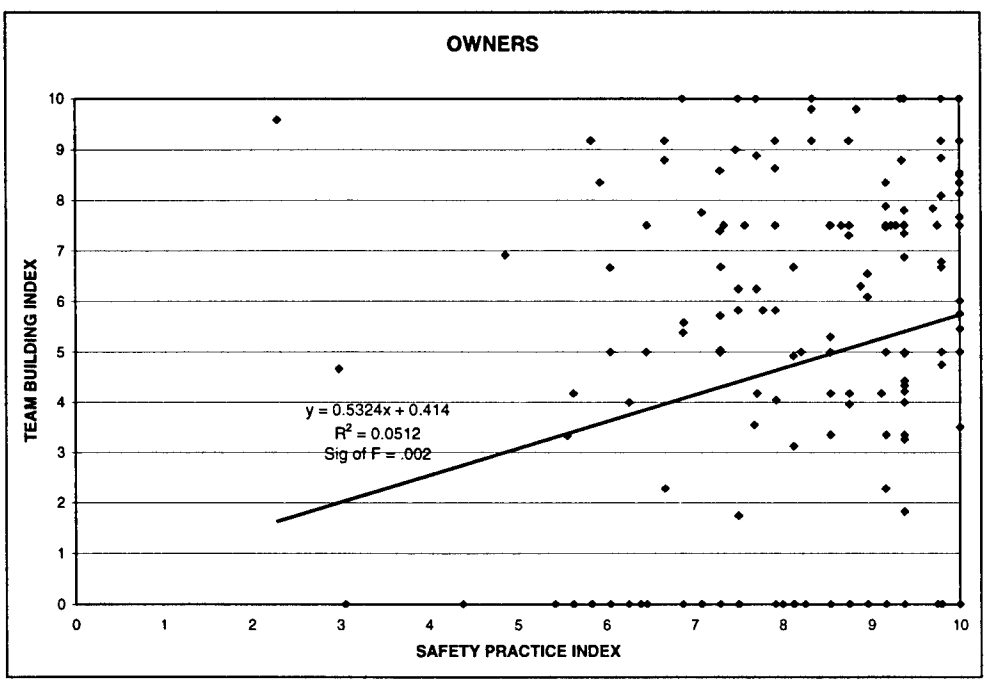


Figure 3: Owners - Relationship between Team Building Index and Safety Practice Index.

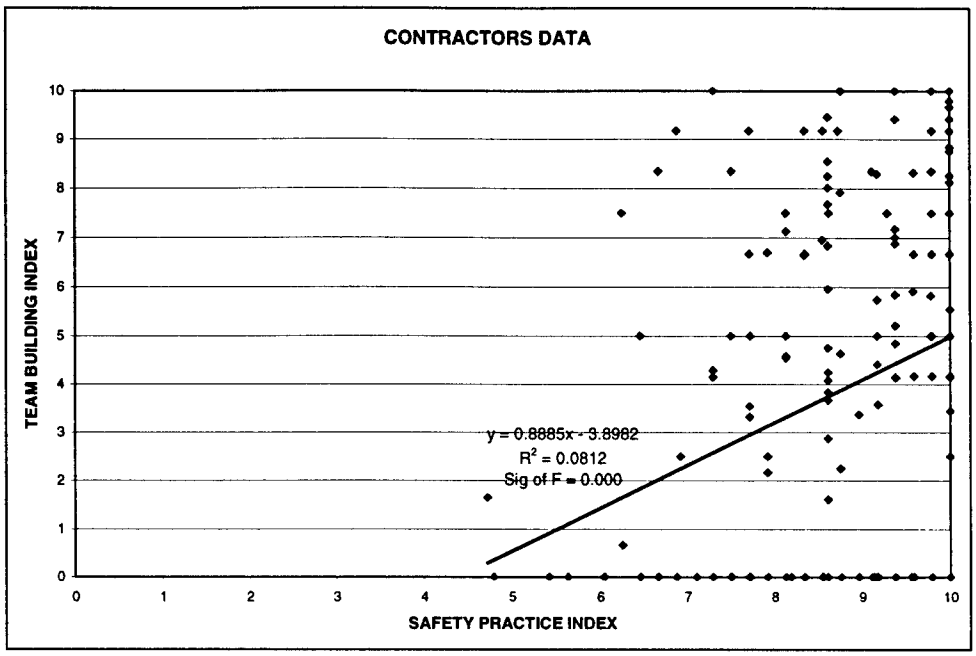


Figure 4: Contractors – Relationship between Team Building Index and Safety Practice Index.

4.3 TEAM BUILDING EFFECTS ON RIR

The relationship between increased safety practices and increased use of team building leads to another question – does team building use affect safety performances? H_0 #2 is that team building use positively affects the RIR safety performance. The trendlines for Figures 5 and 6 seem to indicate that higher team building index scores generally lower the RIR for owners and contractors, respectively. However, there is not a relationship between the team building index score and the RIR metric as indicated by R^2 values of 0.002 and 0.012. In addition, the significance of F value for Figure 5 is 0.556

which means that there is a 56 percent chance that the conclusion could be in error. The significance of F value for Figure 6 is 0.182.

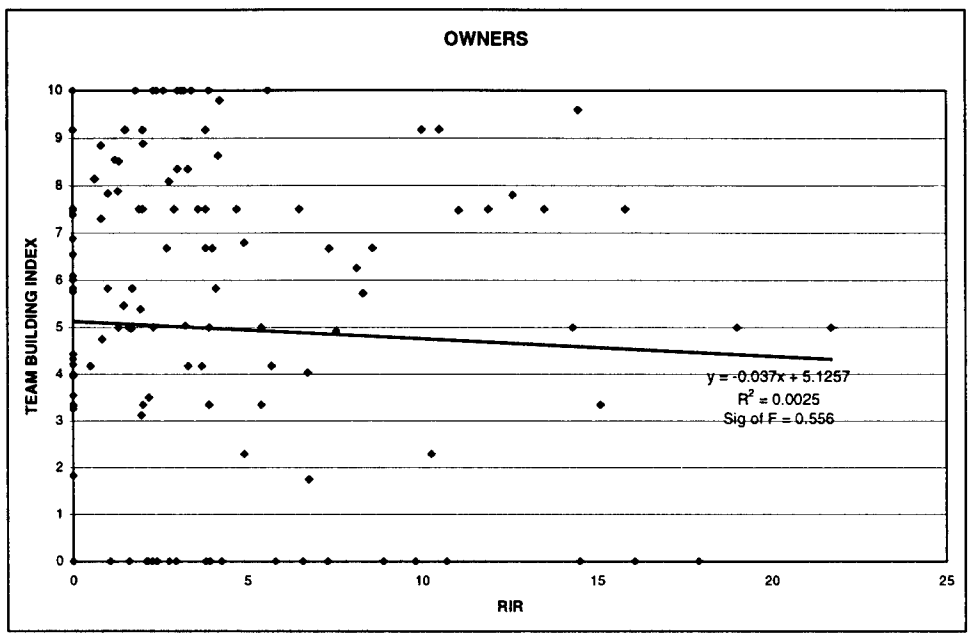


Figure 5: Owners – Team Building Index versus RIR.

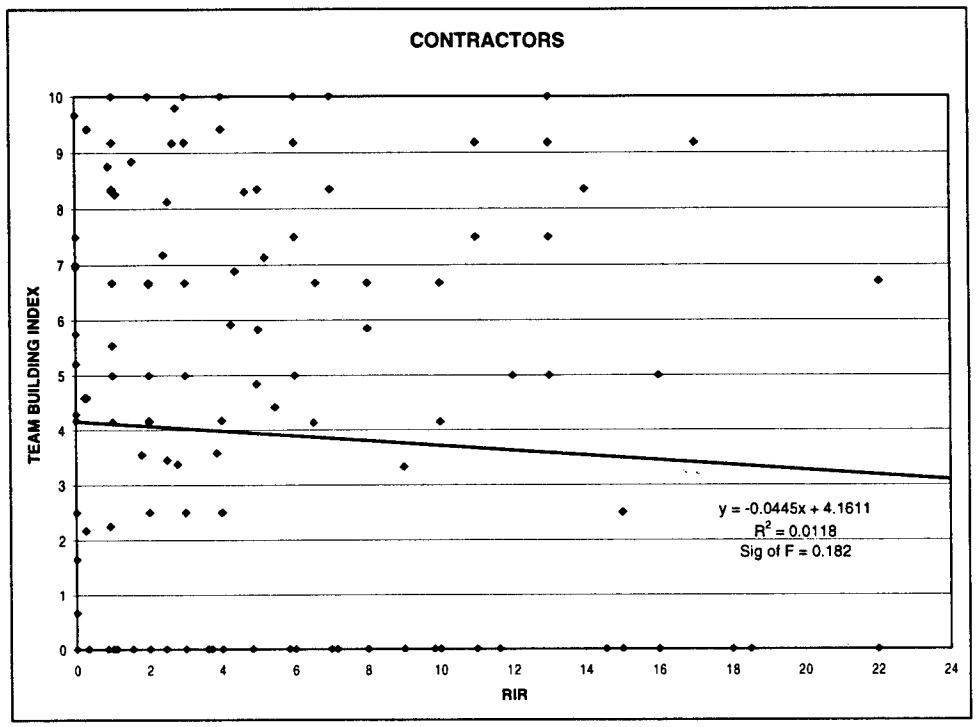


Figure 6: Contractors – Team Building Index versus RIR.

ANOVA tests were run on RIR safety performance data. The results are shown in Tables 4 and 5 for owners and contractors, respectively. The tables show the source of variation and the interaction between sources with respect to RIR. For example, the first three rows that contain data in Table 4 are for project cost with respect to RIR. The first row indicates how RIR is affected by team building. The second row indicates how RIR is affected by project cost. The third row indicates how RIR is affected by team building and project cost combined. Rows four through six show how RIR interacts with team building, craft workhours, and the interaction between team

building and craft workhours. In addition, P-values are given in the tables for each source of variation analyzed.

The results show that there is no statistically significant difference between team building use with respect to project cost or craft workhours on RIR data for both owners and contractors, so the null hypothesis is rejected.

Table 4: Statistical Evaluation Summary of RIR Performance for Owners.

Source of Variation	F	df	P-value
Project Cost			
Team Building	0.73	1, 132	0.393
Project Cost	1.25	3, 132	0.293
TB & Project Cost Interaction	1.10	3, 132	0.352
Craft Workhours			
Team Building	0.03	1, 136	0.859
Craft Workhours	0.45	1, 136	0.502
TB & CW Interaction	0.32	1, 136	0.574

Table 5: Statistical Evaluation Summary of RIR Performance for Contractors.

Source of Variation	F	df	P-value
Project Cost			
Team Building	3.26	1, 105	0.070
Project Cost	2.58	3, 105	0.060
TB & Project Cost Interaction	2.35	3, 105	0.080
Craft Workhours			
Team Building	0.81	1, 109	0.370
Craft Workhours	0.03	1, 109	0.870
TB & CW Interaction	0.04	1, 109	0.841

Although the RIR information analyzed is not significantly different for team building use, the RIR information for both owners and contractors as compared to team building use is interesting. Figure 7 shows that for all projects both owners and contractors have a lower average RIR for projects that employ team building use.

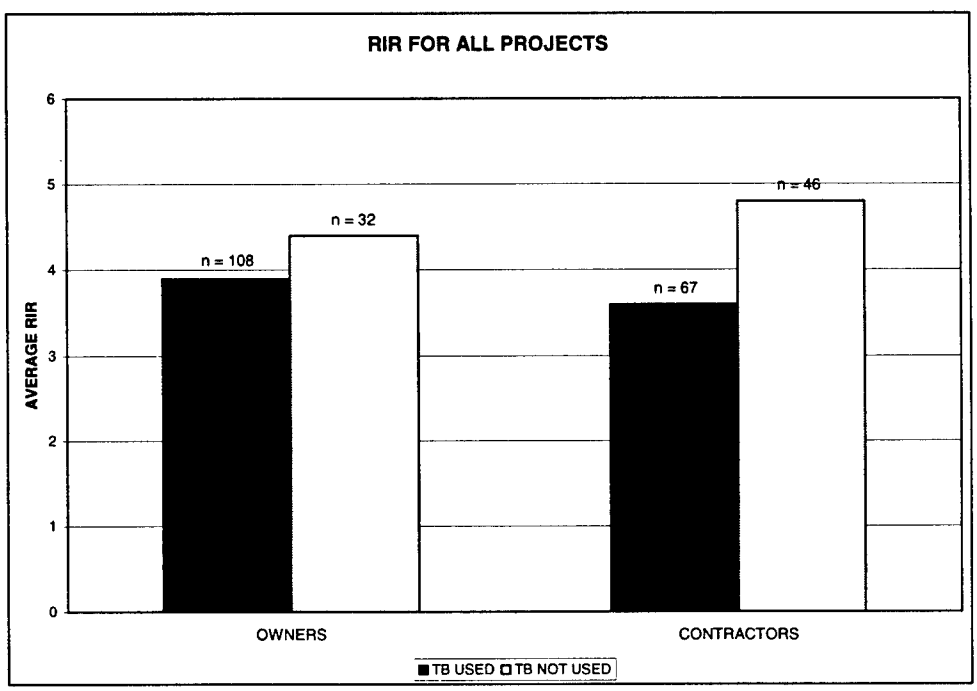


Figure 7: RIR - All Projects, Owners and Contractors.

Figure 8 indicates that for projects costing more than $15 million, the average RIR on projects that use team building is lower than those projects that do not use team building, except for owner projects costing over $100 million. As indicated in Table 3, there is only one project in the owners database for

project costs of more than $100 million in which team building was not used. With only one project to use in a comparison, a good determination on team building use and RIR for this project cost category cannot be made. For projects that cost less than $15 million, the use of team building does not indicate lower RIR values. Figure 8 also shows the number of projects per project cost sub-sample as listed above each category result.

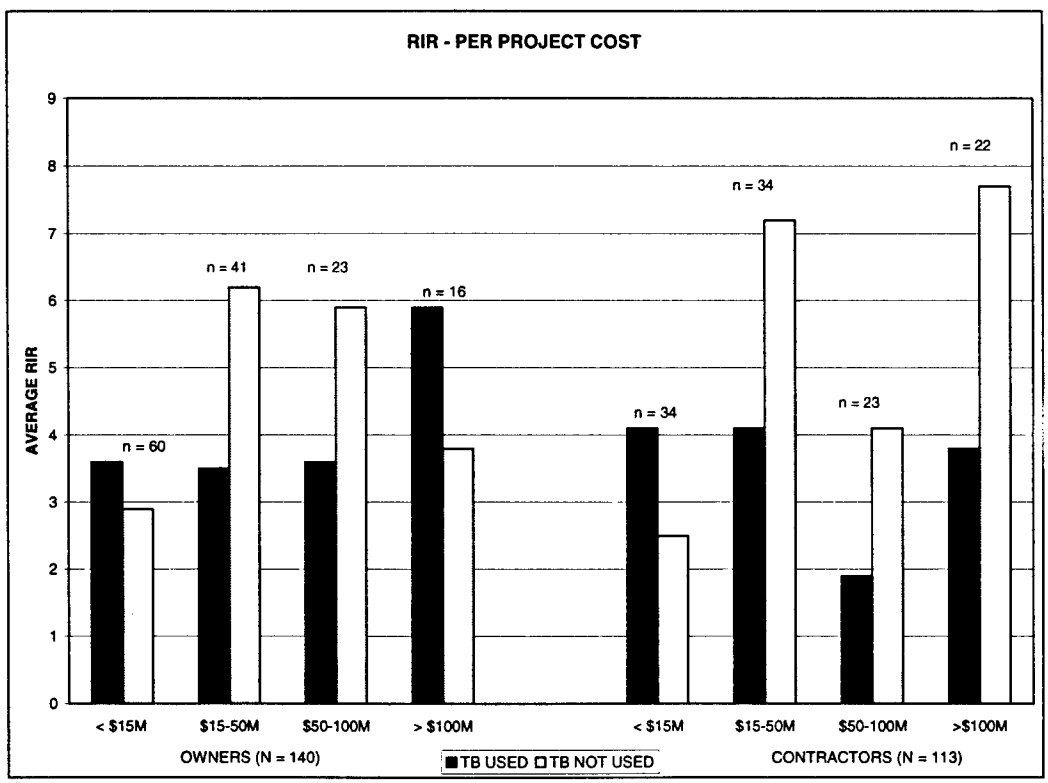


Figure 8: RIR Per Project Cost.

Figure 9 shows the average RIR based on team building use and craft workhours. There are no trends indicated for owner projects. This may be in part due to the low number of projects analyzed that did not use team building. For the last three craft workhour categories, the number of owner projects analyzed that did use team building is three to five times the number of projects that did not use team building. This difference could have caused the data to be inconclusive. Also, the second craft workhour category (100,000-250,000 hours) for contractor projects has a low number of projects analyzed that did not use team building. This may have caused the data to be inconclusive as well. However, the last two categories for contractor projects show an improvement in RIR with the use of team building.

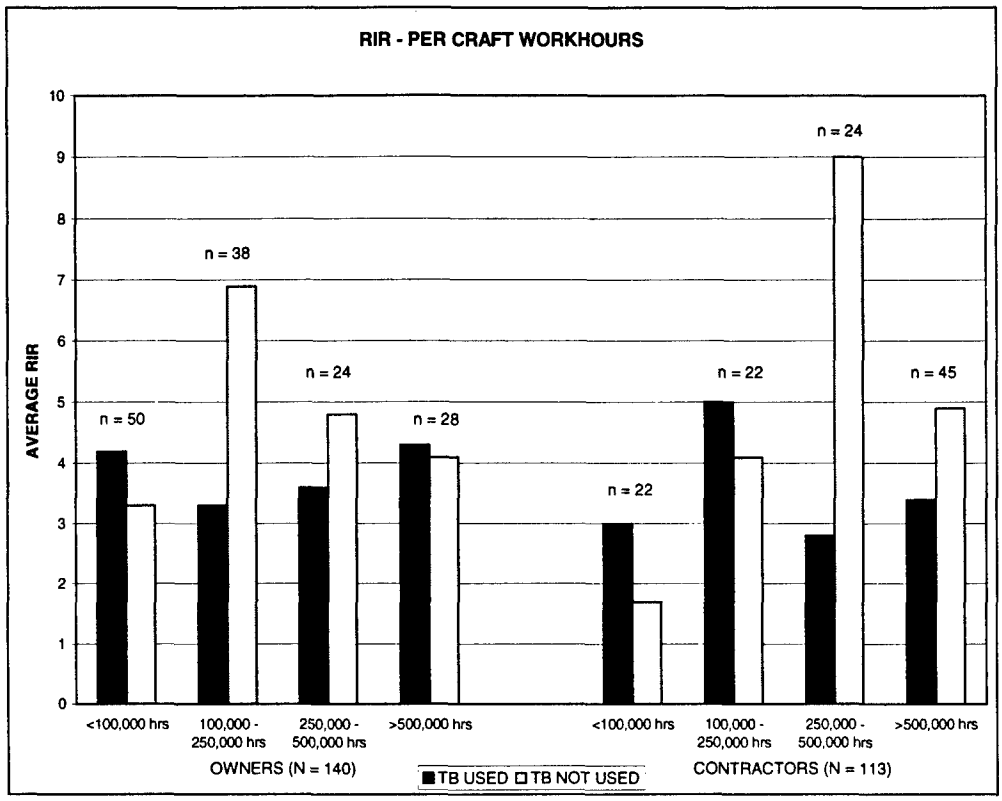


Figure 9: RIR Per Craft Workhours.

4.4 TEAM BUILDING EFFECTS ON LWCIR

Previously, it was noted that best practice index comparisons show that the safety practice index and the team building index are correlated. This does not necessarily indicate that safety performance is better with an increased team building index score. However, H_0 #3 is that team building use positively affects LWCIR safety performance. Figure 10 shows that there is an inverse relationship between team building index scores and the LWCIR for owners. In contrast, Figure 11 shows that there is a negative

effect of team building use on LWCIR for contractors. However, with R^2 values of 0.0005 and 0.0021, respectively, for these two figures, there is no relationship between the team building index score and the LWCIR metric.

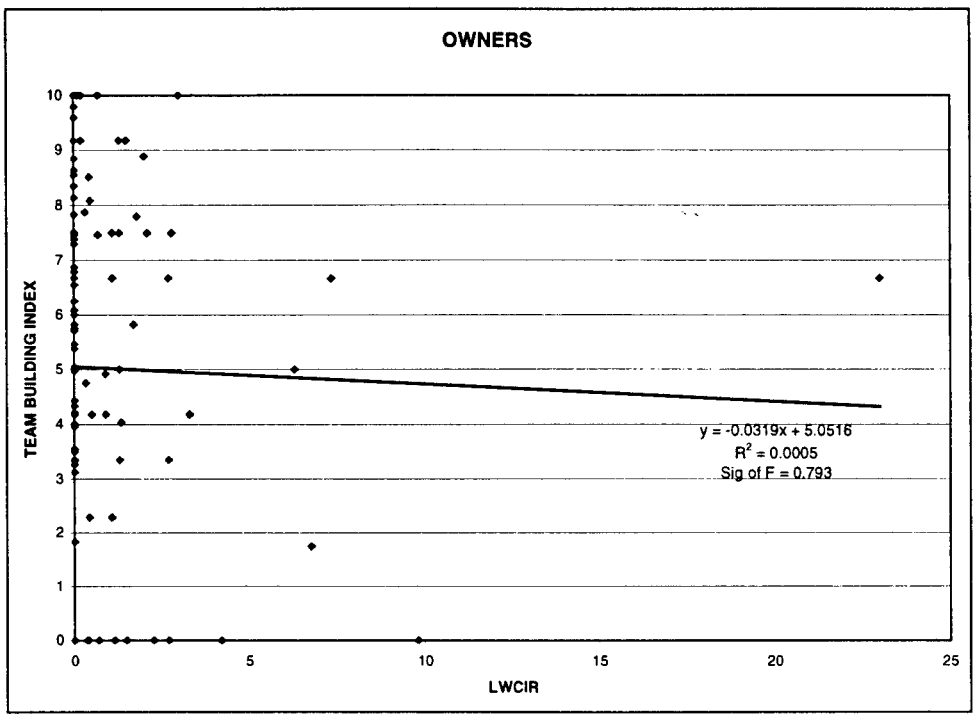


Figure 10: LWCIR versus Team Building Index for Owners.

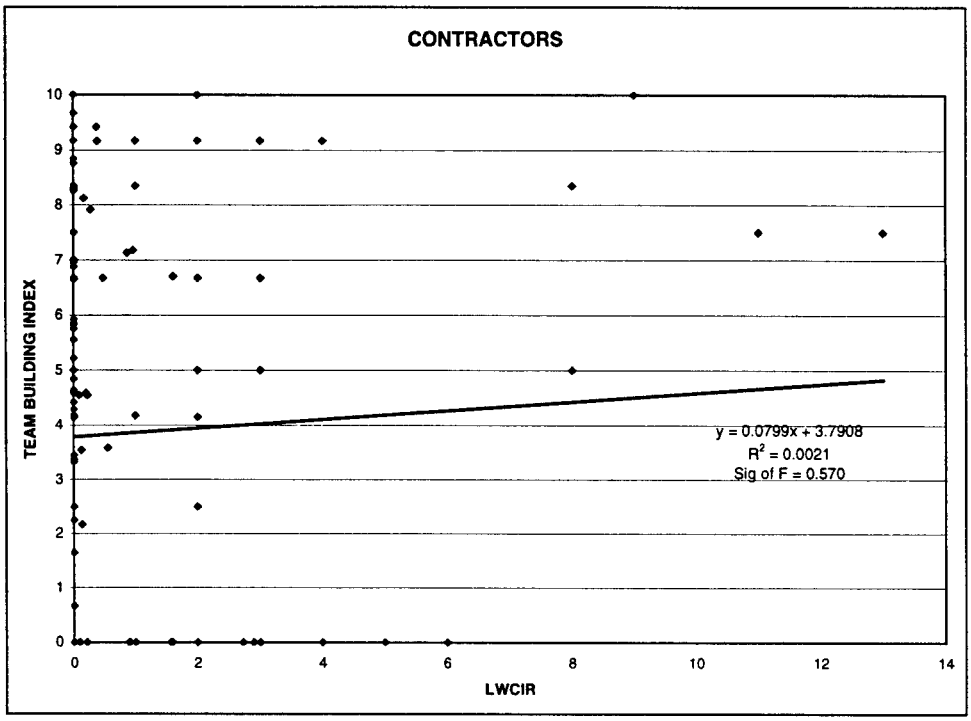


Figure 11: LWCIR vs. Team Building Index for Contractors.

ANOVA tests were run on LWCIR safety performance data. The results are shown in Tables 6 and 7 for owners and contractors, respectively. The tables show the source of variation and the interaction between sources with respect to LWCIR. In addition, the tables give the P-value for each source of variation analyzed.

The results show that there is no statistically significant difference between team building use with respect to project cost or craft workhours on LWCIR data for both owners and contractors, so the null hypothesis is rejected.

Table 6: Statistical Evaluation Summary of LWCIR Performance for Owners.

Source of Variation	F	df	P-value
Project Cost			
Team Building	0.00	1, 132	0.979
Project Cost	2.11	3, 132	0.101
TB & Project Cost Interaction	0.27	3, 132	0.848
Craft Workhours			
Team Building	0.01	1, 136	0.924
Craft Workhours	0.01	1, 136	0.918
TB & CW Interaction	0.01	1, 136	0.941

Table 7: Statistical Evaluation Summary of LWCIR Performance for Contractors.

Source of Variation	F	df	P-value
Project Cost			
Team Building	1.15	1, 105	0.287
Project Cost	1.73	3, 105	0.165
TB & Project Cost Interaction	0.04	3, 105	0.990
Craft Workhours			
Team Building	0.15	1, 109	0.696
Craft Workhours	1.00	1, 109	0.320
TB & CW Interaction	0.26	1, 109	0.614

Although the LWCIR information analyzed is not significantly different for team building use, the LWCIR information for contractors as compared to team building use indicates some differences. Figure 12 shows that the use of team building appears to lower average LWCIR for contractors.

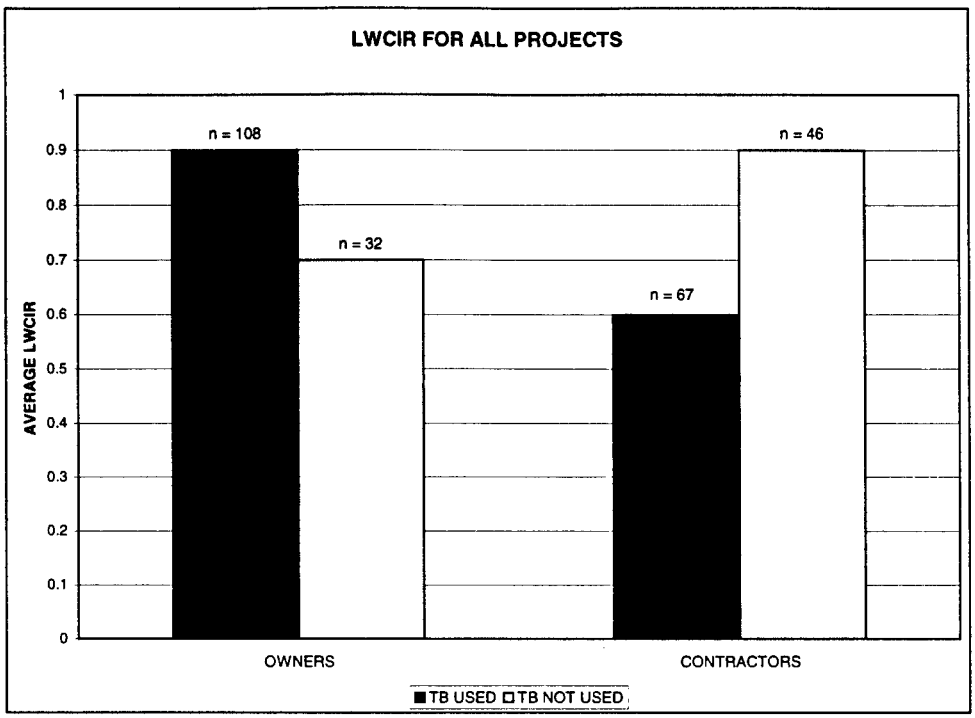


Figure 12: LWCIR – All Projects, Owners and Contractors.

In Figure 13 all four project cost categories for contractor data show that team building use results in a lower LWCIR than for those projects that did not use team building. However, in Figure 14 LWCIR data for team building use and craft workhours for contractors indicates this same trend of lower LWCIR for projects that used team building but is inconclusive since all categories do not indicate this same trend. Owner data shows that team building use appears to result in a higher average LWCIR as shown in all three of these figures.

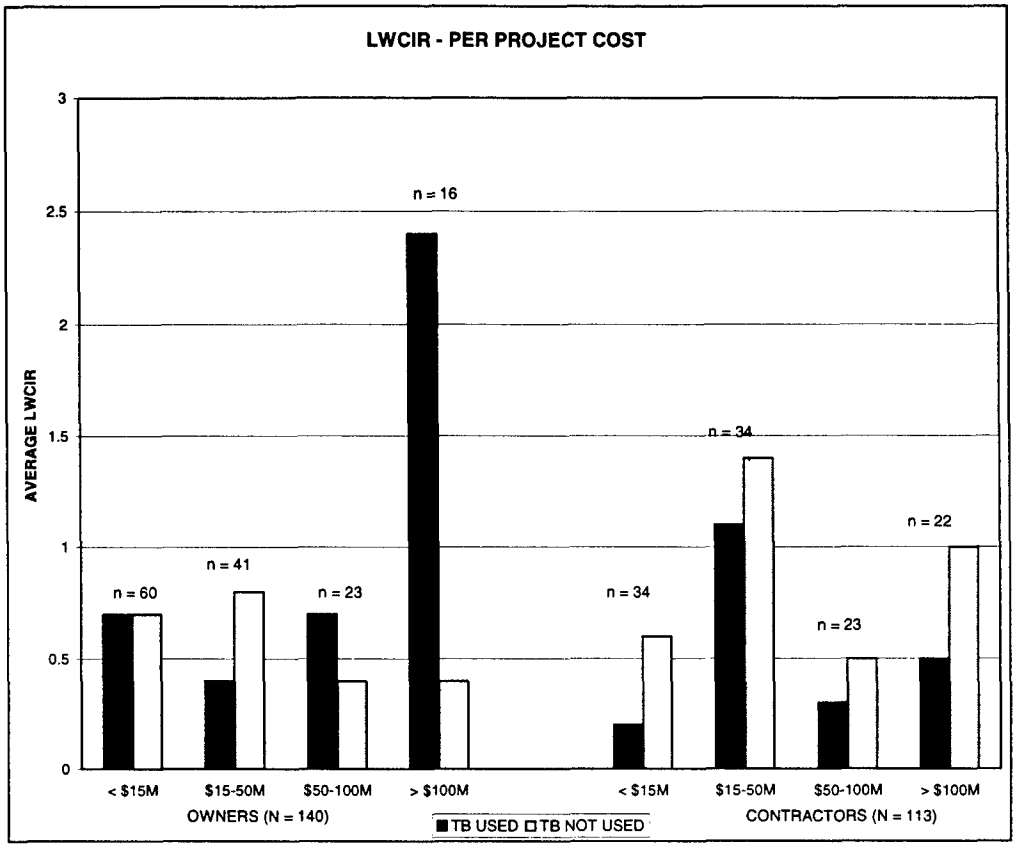


Figure 13: LWCIR per Project Cost.

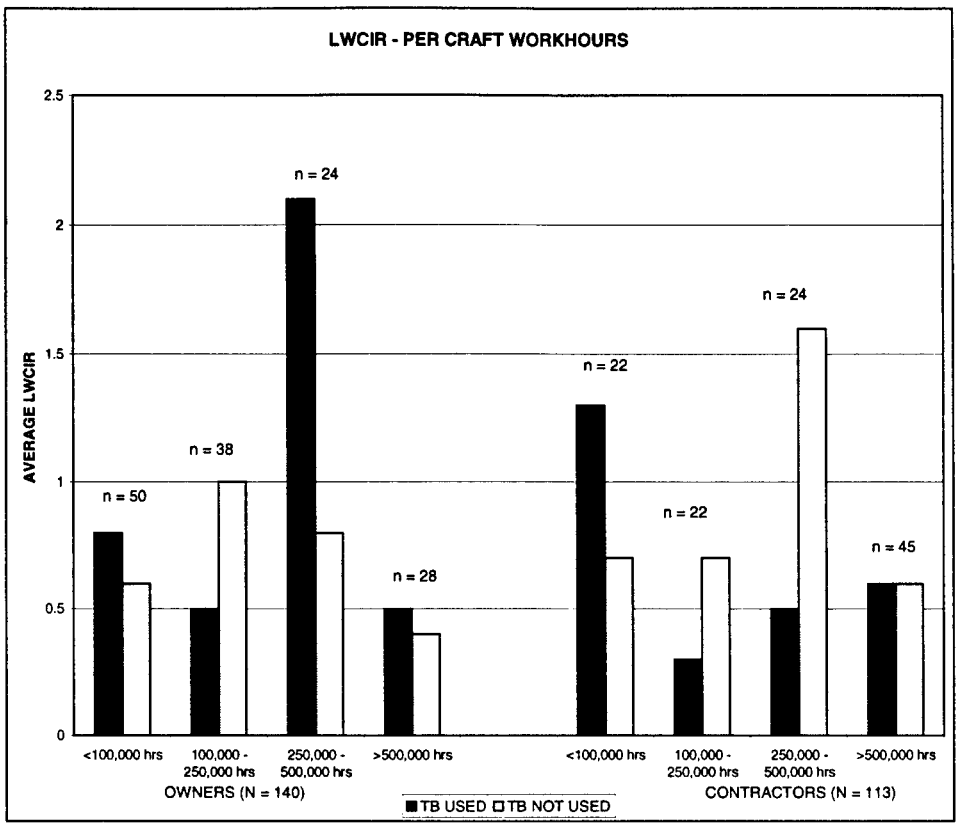


Figure 14: LWCIR per Craft Workhours.

4.5 TEAM BUILDING EFFECTS ON ZERO RECORDABLES

H_0 #4 is that team building use positively affects the number of projects with zero recordables. ANOVA tests were performed on safety performance data for recordable incidents to test this hypothesis. The results are shown in Tables 8 and 9 for owners and contractors, respectively. The tables show the source of variation and the interaction between sources with

respect to zero recordables. In addition, the tables give the P-value for each source of variation analyzed.

Table 8: Statistical Evaluation Summary of Recordable Injuries for Owners.

Source of Variation	F	df	P-value
Project Cost			
Team Building	0.06	1, 132	0.811
Project Cost	39.78	3, 132	0.000
TB & Project Cost Interaction	2.08	3, 132	0.106
Craft Workhours			
Team Building	2.27	1, 136	0.134
Craft Workhours	20.71	1, 136	0.000
TB & CW Interaction	3.33	1, 136	0.070

Table 9: Statistical Evaluation Summary of Recordable Injuries for Contractors.

Source of Variation	F	df	P-value
Project Cost			
Team Building	6.429	1, 105	0.013
Project Cost	19.26	3, 105	0.000
TB & Project Cost Interaction	3.78	3, 105	0.013
Craft Workhours			
Team Building	2.20	1, 105	0.141
Craft Workhours	8.67	3, 105	0.000
TB & CW Interaction	5.73	3, 105	0.634

The results show that there are statistically significant differences in sub-samples for both owners and contractors which confirm the null hypothesis. As shown in Table 9, the interaction between team building and project cost with respect to recordable injuries for contractor projects shows a

statistically significant difference using an alpha level of 0.05. In addition to this, the interaction between team building use and craft workhours with respect to recordable injuries for owner projects is statistically significant using an alpha level of 0.10 as shown in Table 8. Also, the interaction between team building use and project cost with respect to zero recordables for owners is just outside the 0.10 alpha level at 0.106 as shown in Table 8. For these relationships, the null hypothesis is confirmed.

For contractor projects the interaction between team building use and craft workhours with respect to zero recordables shows an alpha level of 0.634, which is not statistically significant. This follows the hypothesis that team building use does not effect the number of recordable incidents.

However, there were four other comparisons for recordable injuries shown in Tables 8 and 9 that show statistically significantly results as well, without interaction with team building use. They are project cost with respect to recordable injuries for both owners and contractors and craft workhours with respect to recordable injuries for both owners and contractors. All of these show exact relationships of 0.000 as shown in Tables 8 and 9. This means that zero recordable performance is affected by project cost and, separately, by craft workhours.

The contractor projects show this relationship between mean number of recordable incidents and project cost, and separately, for craft workhours as shown in Tables 10 and 11, respectively. Table 10 shows that as project cost increases, the mean number of recordable incidents generally increases

for contractor projects that used team building and for contractor projects that did not use team building. However, the projects that used team building showed a much slower rate of increase in the mean number of recordable incidents compared to those that did not use team building. So, team building use appears to have a positive effect by reducing the mean number of recordable incidents.

Table 10: Mean Recordable Incidents per Project Cost Category and Team Building Use for Contractors.

Contractor Data	Means	
Project Cost Category	Team Building Used	Team Building Not Used
< $15 M	3.06	1.61
$15 – 50 M	7.14	16.15
$50 – 100 M	6.57	14.00
> $100 M	31.88	71.83

Table 11: Mean Recordable Incidents per Craft Workhour Category for Contractors.

Contractor Data	Means	
Project Cost Category	Team Building Used	Team Building Not Used
< 100K hours	0.70	0.50
100K - 250K hrs	4.13	2.86
250K - 500K hrs	5.29	18.90
> 500K hrs	23.50	34.18

Table 11 shows that the mean number of recordable incidents increases as the craft workhours increase. However, it also shows that team

building use has a tendency to slow the increase in the mean number of recordable incidents.

Figure 15 shows that, for both owners and contractors, the projects that did not use team building had a greater chance of achieving zero recordables than the ones that used team building. This is a negative result for team building use, but it is buffered by the fact that all categories in Figure 15 have less than 35 percent of their projects with zero recordables.

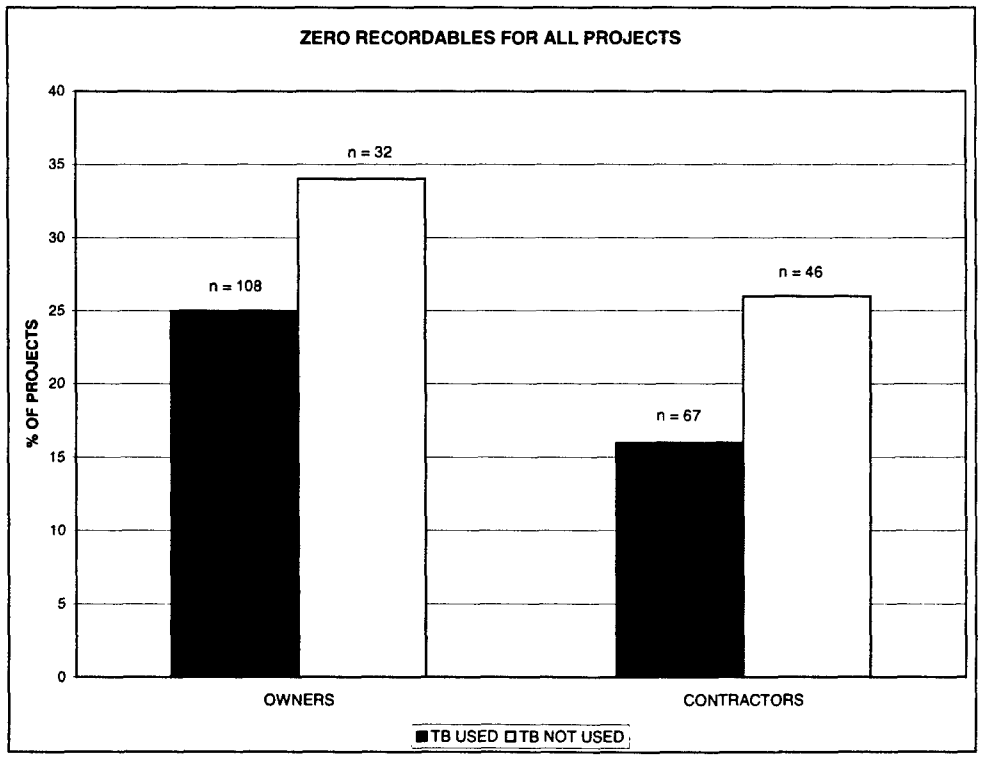


Figure 15: Zero Recordables – All Projects, Owners and Contractors.

Additionally, Figure 16, which measures the percentage of projects that have zero recordables, seems to indicate that using team building has a minimal effect on the number of projects with zero recordables for owners, but does not indicate an effect for contractor projects. It is interesting to note that there were no zero recordable projects for owners or contractors on projects that cost over $100 million.

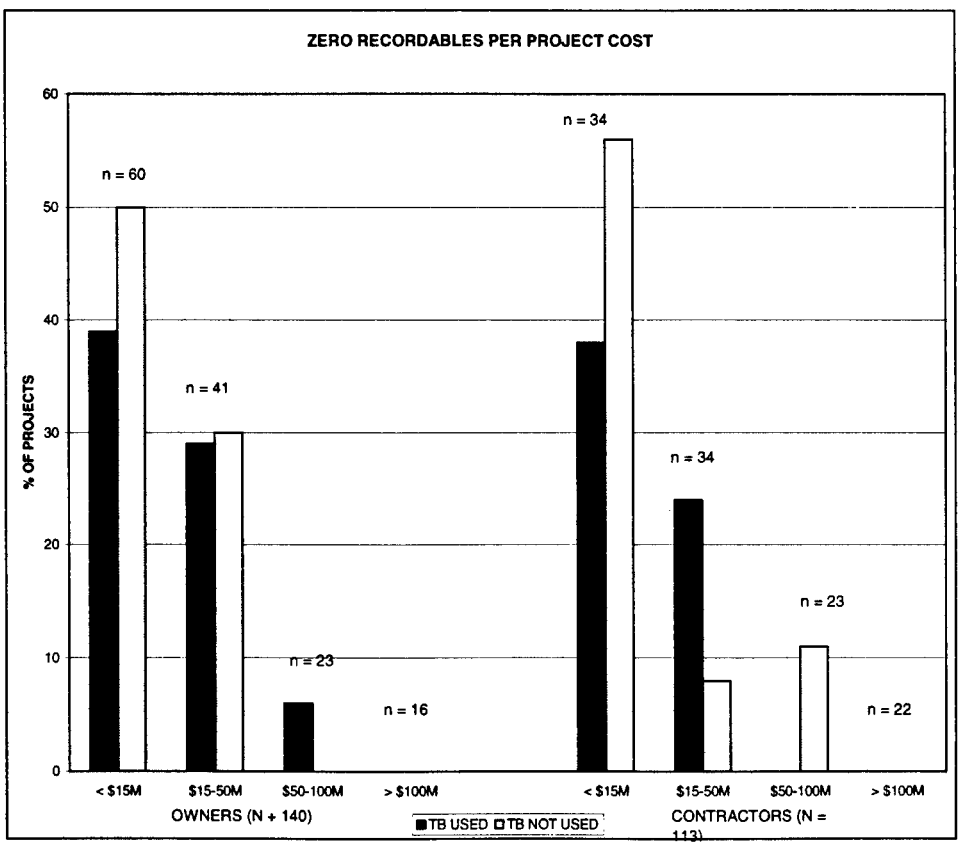


Figure 16: Zero Recordables per Project Cost.

Figure 17 shows the percentage of projects that had zero recordables per craft workhour category. Except for the first craft workhour category, owner projects seem to benefit from using team building with respect to zero recordables. However, the contractor data are inconclusive as to whether or not team building use increases the number of projects with zero recordables. Although using team building may not affect the number of zero recordables on contractor projects, categorized by craft workhours, it does affect the mean number of recordable incidents as discussed previously.

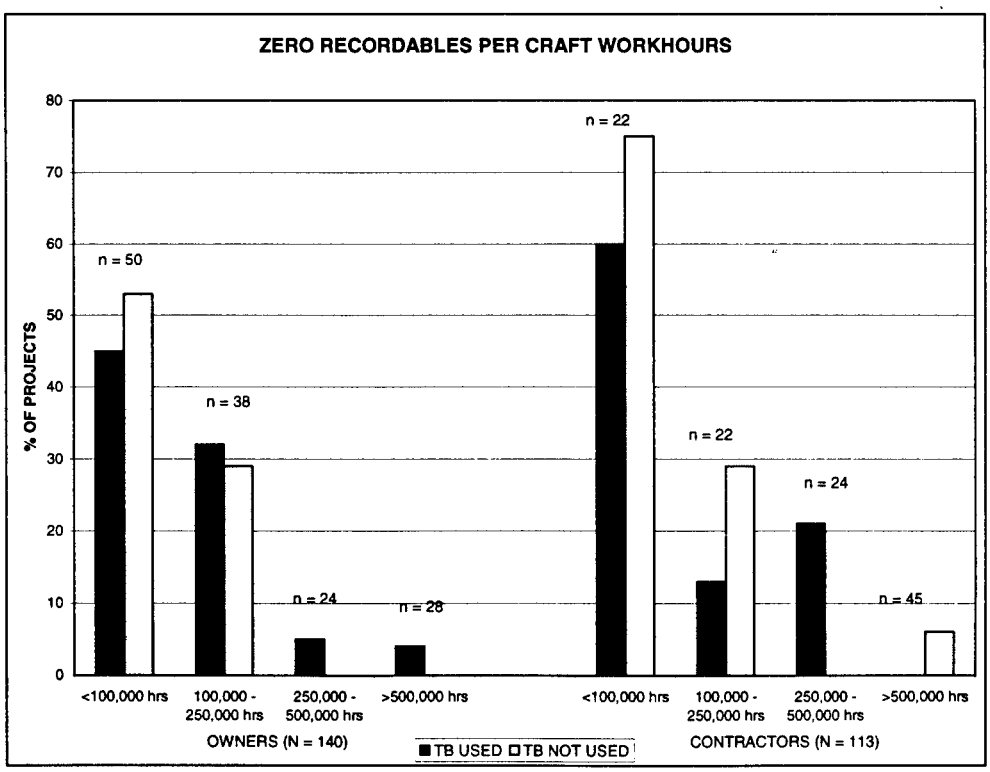


Figure 17: Zero Recordables per Craft Workhours.

4.6 TEAM BUILDING EFFECTS ON ZERO LOST WORKDAY CASES

H_0 #5 is that team building use positively affects the number of projects with zero lost workday cases. ANOVA tests were performed on safety performance data for lost workday cases to test this hypothesis. The results are shown in Tables 12 and 13 for owners and contractors, respectively. The tables show the source of variation and the interaction between sources with respect to zero recordables. In addition, the tables give the P-value for each source of variation analyzed.

Results shown in the tables indicate that there are some statistically significant differences in data for both owners and contractors but not with regard to team building use. For both owners and contractors, the data are statistically significant at the 0.05 alpha level for project cost with respect to lost workday cases without considering team building use. In addition, the data are statistically significant at the 0.10 alpha level for craft workhours with respect to lost workday cases for owner projects.

Since the interaction of team building use with project cost and with craft workhours, for both owner and contractor projects, does not indicate statistically significant results, the null hypothesis is rejected.

Table 12: Statistical Evaluation Summary of Lost Workday Cases for Owners.

Source of Variation	F	df	P-value
Project Cost			
Team Building	0.10	1, 132	0.757
Project Cost	12.89	3, 132	0.000
TB & Project Cost Interaction	0.92	3, 132	0.435
Craft Workhours			
Team Building	0.21	1, 136	0.650
Craft Workhours	3.39	1, 136	0.068
TB & CW Interaction	0.67	1, 136	0.415

Table 13: Statistical Evaluation Summary of Lost Workday Cases for Contractors.

Source of Variation	F	df	P-value
Project Cost			
Team Building	1.85	1, 105	0.177
Project Cost	6.28	3, 105	0.001
TB & Project Cost Interaction	0.83	3, 105	0.481
Craft Workhours			
Team Building	0.28	1, 112	0.598
Craft Workhours	0.05	1, 112	0.818
TB & CW Interaction	2.09	1, 112	0.151

When reviewing mean lost workday cases per project cost category, the owner data do not show any patterns, but the contractor data show a definite trend as shown in Tables 14 and 15, respectively. The contractor

data show that using team building results in lower mean lost workday cases in every cost category.

Table 14: Mean Lost Workday Cases per Project Cost Category for Owners.

Owner Data	Means	
Project Cost Category	Team Building Used	Team Building Not Used
< $15 M	0.25	0.19
$15 – 50 M	0.35	0.90
$50 – 100 M	1.67	0.80
> $100 M	7.00	1.00

Table 15: Mean Lost Workday Cases per Project Cost Category for Contractors.

Contractor Data	Means	
Project Cost Category	Team Building Used	Team Building Not Used
< $15 M	0.25	0.33
$15 – 50 M	1.38	2.85
$50 – 100 M	1.00	1.33
> $100 M	4.31	8.50

Figure 18 shows that using team building has a positive effect on contractor projects but does not improve the number of owner projects with zero lost workday cases. Figures 19 and 20 expand on this positive effect for contractor projects. All project cost categories and all craft workhour

categories show better performance with the use of team building for contractor projects.

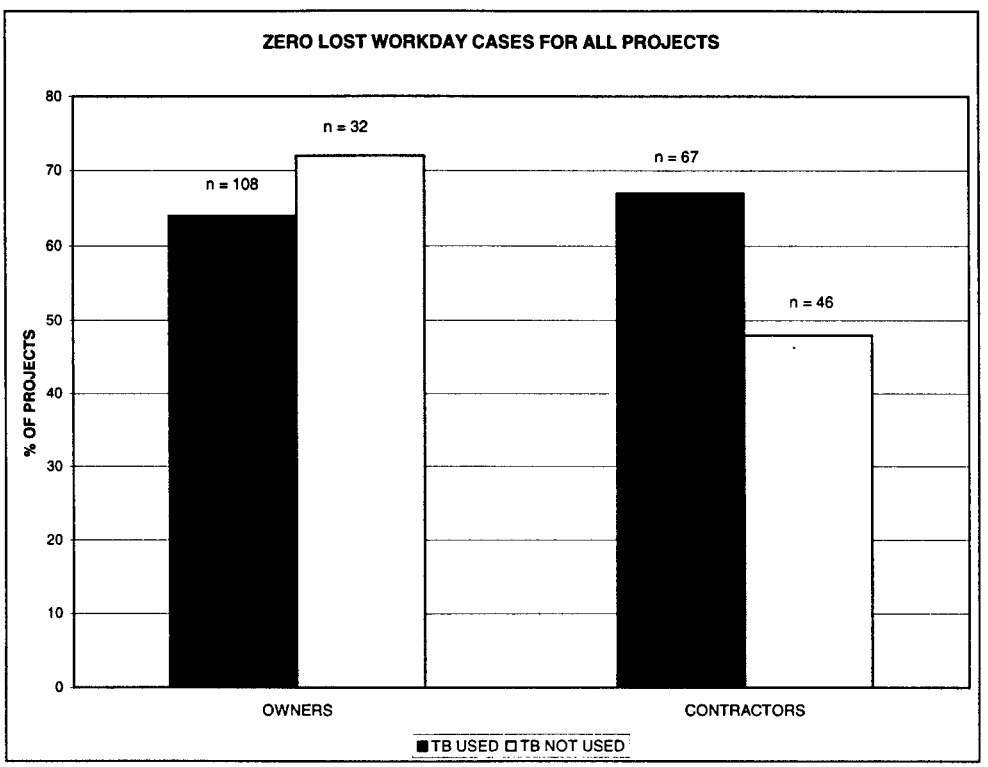


Figure 18: Zero Lost Workday Cases for All Projects.

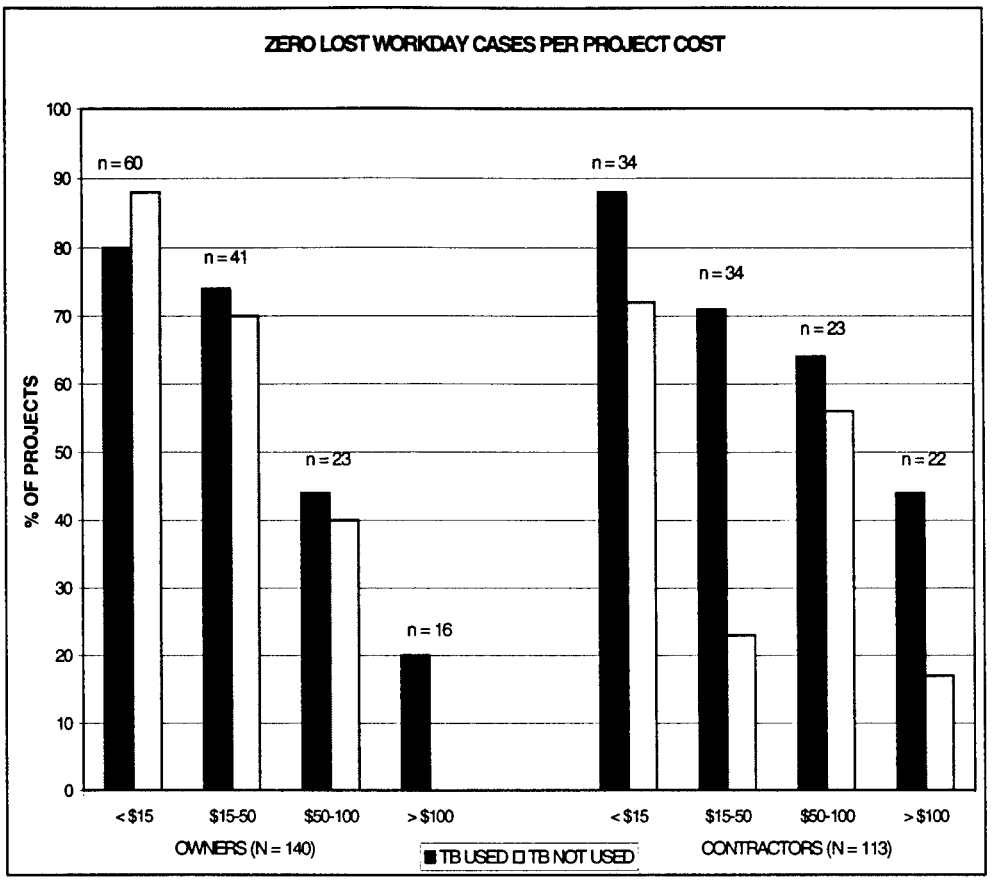


Figure 19: Zero Lost Workday Cases per Project Cost.

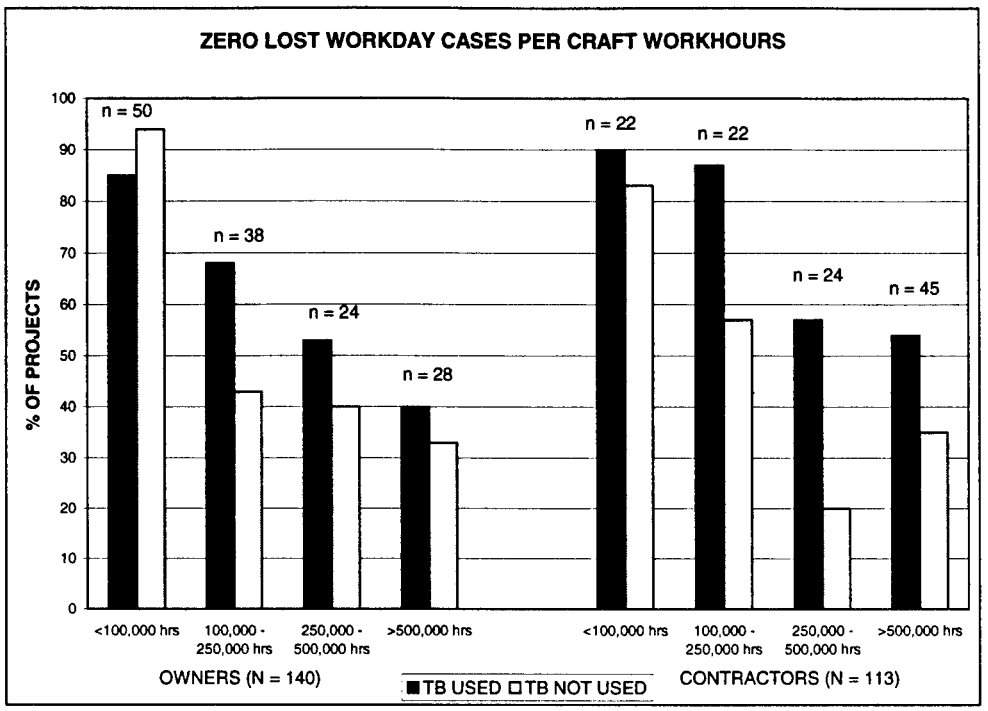


Figure 20: Zero Lost Workday Cases per Craft Workhours.

Owner projects also show some good trends in Figures 19 and 20. Except for the first category in both figures, owner projects that used team building have a greater percentage of projects with zero lost workday cases than those projects that did not use team building.

4.7 SAFETY PRACTICES

H_0 #6 is that team building use leads to more use of safety best practices. ANOVA tests were performed for team building use with respect to safety practices to test this hypothesis. These results are shown in Table

16 for both owners and contractors. Several categories for contractors contained insufficient variation in data for the tests to be performed (that is, all or nearly all of the projects performed this safety practice whether team building was used or not). Those categories are indicated by "NA".

At the 0.05 alpha level, the only comparison that is statistically significant different was team building use with respect to pre-hire testing for owner projects. However, at the 0.10 alpha level, there are three comparisons that are statistically significant. They are team building use with respect to pre-hire testing for contractor projects, team building use with respect to random drug tests for owners and team building use with respect to accidents investigated for owners. The reasons for these differences are unclear.

Table 16: Statistical Evaluation Summary for Safety Practices

	P-value	
Safety Practice	**Contractors**	**Owners**
TB vs. Pre-Task Planning	NA	0.440
TB vs. Employee Orientation	0.410	0.588
TB vs. Employee Incentives	0.613	0.165
TB vs. Pre-hire testing	0.105	0.001
TB vs. Random drug tests	0.582	0.079
TB vs. Testing after accidents	NA	0.212
TB vs. Accidents Investigated	NA	0.065
TB vs. Near-misses investigated	NA	0.212
TB vs. Sr. Mgt. Review	NA	0.346

Figure 21 shows information on three different safety practices, and it indicates that for two of them, pre-task planning and employee orientation

(i.e., orientation for new employees), nearly 100% of owner and contractor projects perform these practices. Thus, there is not a comparison on whether or not team building affects these two practices.

For both owner and contractor projects, Figure 21 also shows that using team building results in a higher percentage of projects that have employee incentives for safety than when not using team building.

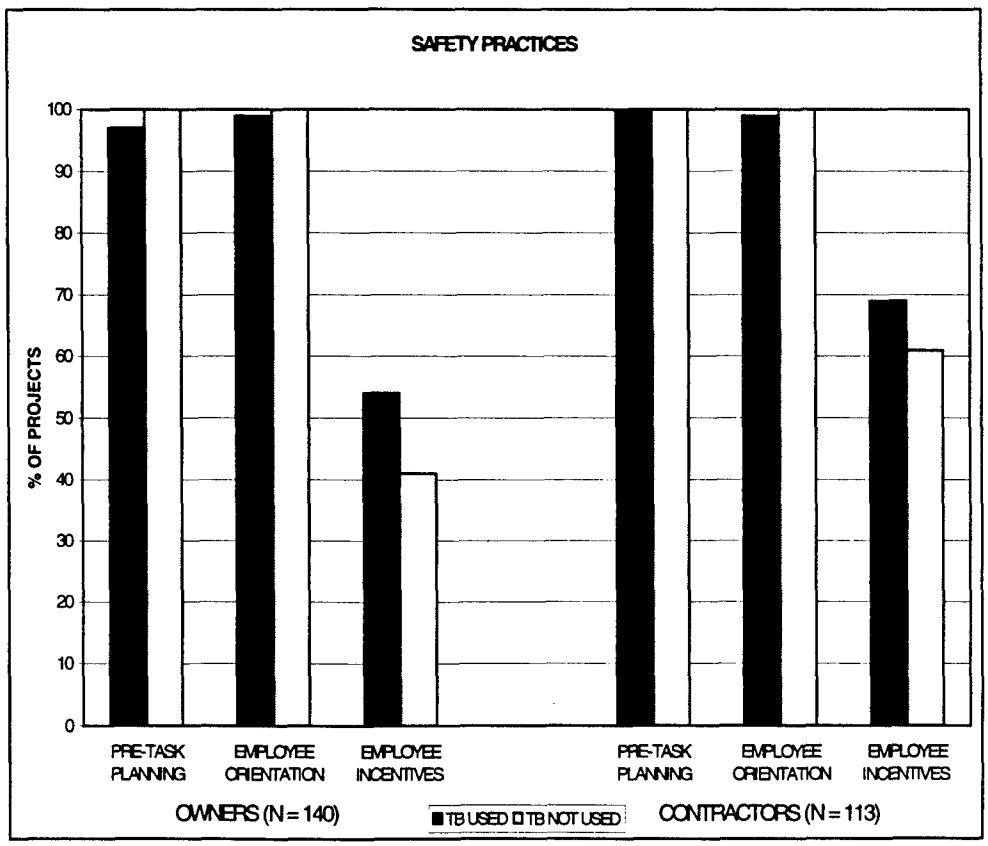


Figure 21: Safety Practices and Team Building Use.

Figure 22 shows that team building appears to have a positive effect on substance abuse programs. All three categories, for both owners and contractors, show that a greater percentage of projects have instituted these programs if they have also used team building. The implication of this finding is unclear. One possibility is that companies employing team building are also likely to have effective safety programs.

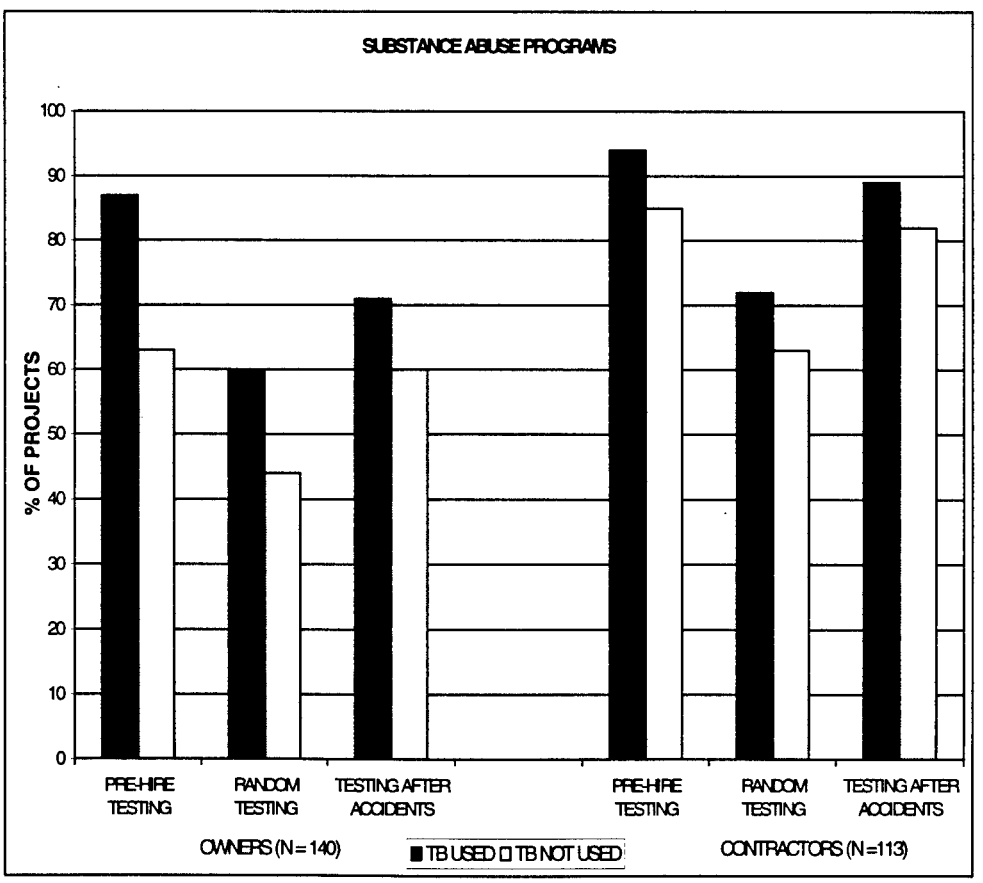


Figure 22: Substance Abuse Programs and Team Building Use.

Accident investigations seem to be almost a common safety practice on all projects. For each category, and for both owners and contractors, 88 percent or more of the projects employed these practices as shown in Figure 23. Even so, there were slightly more projects that employed them if they also used team building as indicated for both owners and contractors.

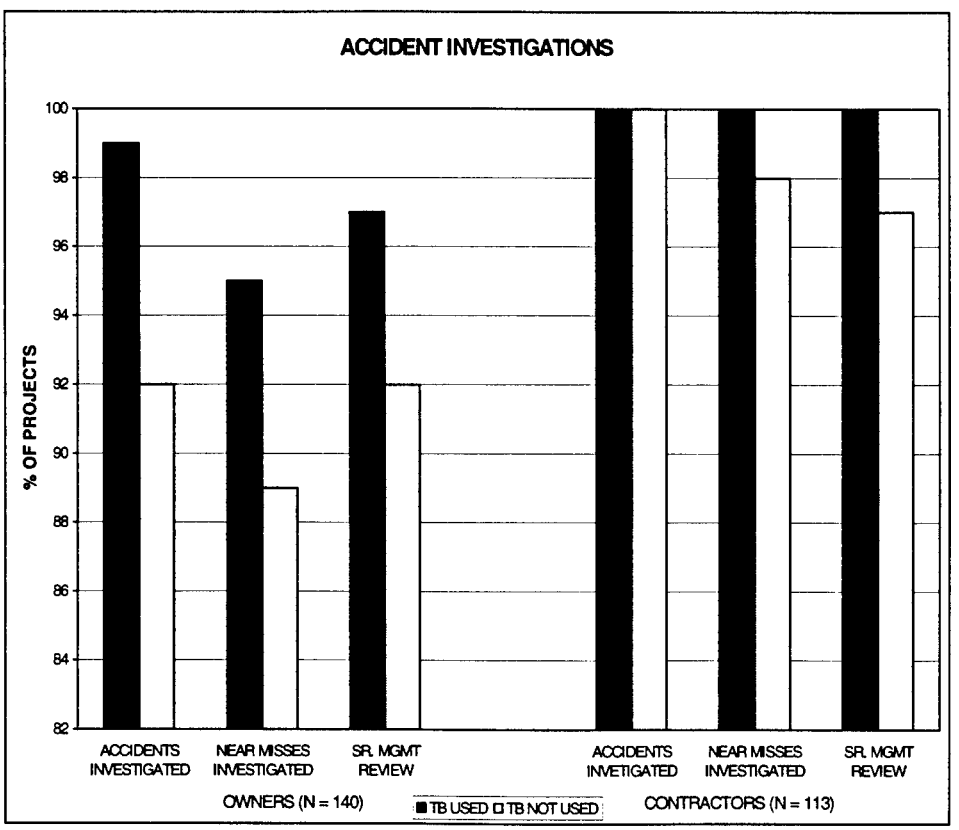


Figure 23: Accident Investigations and Team Building Use.

4.8 SUMMARY

For all of the statistical analysis results given in the data analysis section, care should be used when interpreting the data due to large differences in sample sizes. The CII databases are in their infancy with only two cycles of survey results collected to date. This has resulted in some very small sample sizes for certain population groups. For example, there are only six contractor projects that did not use team building in the project cost size of greater than $100 million. These six projects are compared to eighteen projects that did not use team building in the project cost size of less than $15 million.

5. Conclusions

This study indicates that safety performance and safety practices generally improve with the use of team building for the sample studied. This is particularly true for contractor projects. As shown with marked improvements in various comparisons, contractor projects seem to benefit more from the use of team building than owner projects. However, there were some comparisons analyzed that consisted of relatively small sub-samples. For the most part, the results of this study are not statistically conclusive to say that team building definitely improves safety performance on construction projects. The following specific conclusions are made:

- Analysis of team building in the data sample
  1. Team building was used on a greater percentage of owner projects than contractor projects (77 percent vs. 59 percent).
  2. As project cost increases, the percentage of projects that used team building also increases for both owners and contractors.
  3. Contractor projects with more than 100,000 craft workhours are much more likely to use team building than those with less than 100,000 craft workhours.

- Team building and safety index scores
  1. There is a slight relationship in team building index and safety practice index; increased team building use generally leads to higher safety practices, or vice versa.
  2. All R^2 values found in analyzing team building and safety practice indexes were small indicating weak or no relationships between the index scores.

- Team building use and RIR safety performance
  1. When considering all projects, RIR appears to improve when team building is used.
  2. Team building has inconclusive effects on RIR for projects that cost less than $15 million, but the use of team building appears to improve RIR for projects that cost more than $15 million.
  3. For projects compared by craft workhours, the data are inconclusive on whether team building improves RIR or not.

- Team building use and LWCIR safety performance
  1. For contractor projects, team building appears to improve the LWCIR for all projects, for all project cost categories, and most craft workhour categories.

2. For owner projects, team building appears to result in a higher LWCIR for all projects overall, for projects over $50 million, and for 3 out of 4 of the craft workhour categories.

- Team building use and zero recordables
  1. For contractor projects, team building use appears to slow the increase in the number of recordable incidents as project costs increase and, separately, as craft workhours increase.
  2. For both owners and contractors, a higher percentage of projects that did not use team building had zero recordables than projects that used team building.
  3. With regard to project cost on contractor projects, team building use does not appear to affect the number of projects with zero recordables.
  4. With regard to craft workhours on contractor projects, team building does not appear to affect the number of zero recordables.

- Team building use and zero lost workday cases
  1. For contractor projects, team building appears to result in a lower mean lost workday case in every sample cost category.
  2. All project cost categories and all craft workhour categories show better performance with the use of team building for contractor projects with regard to zero lost workday cases.

3. Team building appears to improve the number of owner projects with zero lost workday cases for all project cost categories greater than $15 million and for all craft workhour categories greater than 100,000 workhours.

- Team building use and safety practices
  1. Nearly 100 percent of owner and contractor projects performed pre-task planning and employee orientation whether team building was used or not used.
  2. Projects that used team building were more likely to have employee incentives for safety than those projects that did not use team building.
  3. Team building use appears to have a positive effect on the use of substance abuse programs in all categories analyzed for both owners and contractors.
  4. Safety practices for accident investigations are used on over 88 percent of the projects for owners and contractors. Even with this high percentage, those projects that also used team building had even higher percentages.

There are many conclusions that can be reached from this analysis. Except for the number of projects with zero recordables and the LWCIR performance for owner projects, team building use appears to either improve

a project or have no effect on it in terms of safety. Thus, team building appears to have little risk associated with its use in terms of safety. Many of the positive conclusions could be used in implementation actions to encourage more wide spread team building use on construction projects. However, the conclusions that are statistically significant or the conclusions that are most likely to have a significant impact, if employed, should be used initially.

These data do not indicate that team building use necessarily improves safety practices. Instead, use of safety practices might improve team building. Additionally, an owner or contractor may make it a company policy to employ most or all of CII's best practices. In fact, well-operated companies probably tend to incorporate multiple good things to improve their performances.

6. Recommendations

6.1 Actions Based on Analysis of Research

The results of this study show that team building appears to help in safety performance and in safety practices for this sample, but that many of the sub-samples are not statistically significant. With only two cycles of survey results gathered so far, the results may become more conclusive as the CII database grows. The following recommendations are offered:

- CII should continue to encourage the use of team building, particularly as a possible way to enhance safety performance.
- CII should encourage the use of team building as a way to encourage the use of safety best practices. Team building should be used to focus on safety issues.
- CII should review project categories that contain low numbers of projects within the sample and try to increase the database in those areas by surveying more owner and contractor organizations that have projects in those categories.

6.2 Recommendations for Future Research

Although CII's annual benchmarking and metrics survey is expanding with each year, there are some problems that should be reviewed

to ensure that the projects in the database contain sufficient information for analyses. The 1996 database contains 94 owner projects and 115 contractor projects, and the 1997 database contains 95 owner projects and 91 contractor projects in the database. However, many of the contractor projects did not report any data on workhours, recordable incidents, and lost workday cases. Because of this, the number of projects that could be analyzed in this study were significantly reduced.

- CII should review the process of getting survey results back from respondents, particularly from contractor sources, to ensure that the information gathered is complete.
- The analysis on the effect of using team building on safety performance and safety practices should be studied again after more projects have been added to the CII database.

Appendices

A - Selected Survey Questions from the CII's 1997 Survey Questionnaire for Owners

Appendix A contains only selected questions from the CII's 1997 Survey Questionnaire for Owners. The data used in this analysis are based on these selected questions.

Survey Questions

2. Your Project I.D. _____ (You may use any reference to protect the project's identity. The purpose of this I.D. is to help you and CII personnel identify the questionnaire correctly if clarification of data is needed and to prevent duplicate project entries.)

3. Project Location: Domestic _____ , USA
State

International _____
Country

10. Project Participants. Please list the companies, including your company, that helped execute this project, but do not list any subcontractors. Indicate the function(s) each company performed and the approximate percent of that function to the nearest 10%. For each function, indicate the principle form of remuneration in use at the completion of the work. Please indicate if each participant was an alliance partner and if their contract contained incentives.

Please use the following codes to identify the **Function** performed by each project participant.

PPP	Pre-Project Planner	DM	Demolition/Abatement Contractor
PPC	Pre-Project Planning Consultant	GC	General Contractor
D	Designer	PC	Prime Contractor
PE	Procurement - Equipment	PM	Project Manager
PB	Procurement - Bulks	CM	Construction Manager

Percent of Function refers to the percent of the overall function contributed by the company listed. Estimate to the nearest 10 percent.

12. Total Actual Project Cost:

- The total actual project cost should include all actual project costs from pre-project planning through startup or to a "ready for use" condition, excluding the cost of land.
- Actual costs should correspond to those that were part of the budget. For example, if the budget included specific amounts for in-house personnel, then actual cost should include the actual amounts expended during the project for their salaries, overhead, travel, etc.
- State the project cost in U.S. dollars to the nearest $1000. (You may use a "k" to indicate thousands in lieu of "...,000".)

$_____

18. Workhours and Accident Data

Please record total craft workhours, the number of recordable injuries, and the number of lost workday cases separately in the spaces provided below.

- Use the U.S. Department of Labor's OSHA definitions for recordable injuries and lost workday cases among this project's craft workers. If you do not track in accordance with these definitions, write "UNK" in the recordable injuries and lost workday cases columns.

- Write "UNK" in any space for which the information is unavailable or incomplete.
- A consolidated project OSHA 200 log is the best source for the data.

Total Craft Workhours	OSHA Recordable Injuries	OSHA Lost Workday Cases

Safety Practices

Safety includes the site-specific program and efforts to create a project environment and state of consciousness which embraces the concept that all accidents are preventable and that zero accidents is an obtainable goal. If this project was accident free, check "NA" as appropriate for questions 27 through 30.

	Yes	No	
19.	___	___	This project had a written site-specific safety plan.
20.	___	___	This project had a written site-specific emergency plan.
21.	___	___	This project had a site safety supervisor.
22.	___	___	The site safety supervisor for this project was full-time.
23.	___	___	This project had a written safety incentive program for hourly craft employees.
24.	___	___	Toolbox safety meetings were required.
25.	___	___	This project required prehire substance abuse testing of contractor employees.
26.	___	___	Contractor employees were randomly screened for alcohol and drugs.

27. Substance abuse tests were conducted after an accident:

_____ Always _____ Sometimes _____ Seldom _____ Never

_____ NA

28. Accidents were formally investigated:

_____ Always _____ Sometimes ___ Seldom ____ Never ___ NA

29. Near-misses were formally investigated:

_____ Always _____Sometimes ____ Seldom __Never __NA

30. Senior management reviewed accidents:

_____ Always _____Sometimes____ Seldom__ Never ___ NA

31. Safety was a high priority topic at all pre-construction and construction meetings:

_____ Always _____ Sometimes _____ Seldom _____ Never

32. Safety records were a criterion for contractor/subcontractor selection:

_____ Always _____ Sometimes _____ Seldom _____ Never

33. Pre-task planning for safety was conducted by contractor foremen:

_____ Always _____ Sometimes _____ Seldom _____ Never

34. Jobsite-specific orientation was conducted for new contractor and subcontractor employees:

_____ Always _____ Sometimes _____ Seldom _____ Never

35. This question is for Contractors only.

Team Building Practices

Team Building is a process that brings together a diverse group of project participants and seeks to resolve differences, remove roadblocks and proactively build and develop the group into an aligned, focused and motivated work team that strives for a common mission and for shared goals, objectives and priorities.

36. Was a team building process used for this project? Yes ___ No ___.

If yes, answer questions 36a - 36h. If no, go to question 37.

Yes No

36a. ___ ___ Was an independent consultant used to facilitate the team building process?

36b. ___ ___ Was a team-building retreat held early in the life of the project?

36c. ___ ___ Did this project have a documented team-building implementation plan?

36d. ___ ___ Were objectives of the team building process documented and clearly defined?

36e. Were team building meetings held among team members throughout the project?

_____ Regularly ___ Sometimes _____ Seldom ___ Never

36f. Were follow-up sessions held to integrate new team members and reinforce concepts?

_____ Regularly ___ Sometimes _____ Seldom ___ Never

36g. Please indicate the project phases in which team building was used. (Check all that apply)

____ Pre-Project Planning
____ Procurement
____ Startup
____ Design
____ Construction

36h. Please indicate the parties involved in the team building process.

(Check all that apply)

____ Owner
____ Contractor(s)
____ Subcontractor(s)
____ Other. If other, please specify
____ Designer(s)
____ Major Suppliers
____ Construction Manager

B - Selected Survey Questions from the CII's 1997 Survey Questionnaire for Contractors

Appendix B contains only selected questions from the CII's 1997 Survey Questionnaire for Contractors. The data used in this analysis are based on these selected questions.

Survey Questions

2. **Your Project I.D.** _____ (You may use any reference to protect the project's identity. The purpose of this I.D. is to help you and CII personnel identify the questionnaire correctly if clarification of data is needed and to prevent duplicate project entries.)

3. **Project Location:** Domestic _____ , USA
(State)
International _____
(Country)

10. Please indicate in the table below the function(s) **your company** performed on this project and the approximate percent of each to the nearest 10%. For each function, indicate the principle form of remuneration in use at the completion of the work. Also indicate if your contract contained incentives. Use a separate line for each function your company performed.

    Please use the following codes to identify the **Function(s)** performed by your company.

PPP	Pre-Project Planner	DM	Demolition/Abatement Contractor
PPC	Pre-Project Planning Consultant	GC	General Contractor
D	Designer	PC	Prime Contractor
PE	Procurement - Equipment	SC	Subcontractor
PB	Procurement - Bulks	PM	Project Manager
		CM	Construction Manager

Percent of Function refers to the percent of the overall function contributed by your company. Estimate to the nearest 10 percent.

12. Your company's *Total Actual Project Cost*:

- This is the actual cost of your company's portion of the project only (not the total cost of the entire project). If possible, do not include corporate overhead.
- Do not include profit.
- **Include** the cost of executing change orders.
- State your companys' Total Actual Project Cost in U.S. dollars to the nearest $1000. (You may use a "k" to indicate thousands in lieu of "...,000".)

$_____

18. Workhours and Accident Data

Please record the total craft workhours, the number of recordable injuries, and the number of lost workday cases for your company and your subcontractors separately in the spaces provided below.

- Use the U.S. Department of Labor's OSHA definitions for recordable injuries and lost workday cases among this project's craft

workers. If you do not track in accordance with these definitions, write "UNK" in the recordable injuries and lost workday cases columns.

- Write "UNK" in any space for which the information is unavailable or incomplete. Write "NA" if your company was not involved in the construction phase or provided inspection services only.

- A consolidated project OSHA 200 log is the best source for the data.

	Total Craft Workhours	OSHA Recordable Injuries	OSHA Lost Workday Cases
Your Direct-Hire Craft Employees			
Subcontractor Craft Employees			

Safety Practices

Safety includes the site-specific program and efforts to create a project environment and state of consciousness which embraces the concept that all accidents are preventable and that zero accidents is an obtainable goal. If this project was accident free, check "NA" as appropriate for questions 27 through 30.

If your company was not involved in the construction phase, go to question 36.

Yes No

19. __ __ This project had a written site-specific safety plan.

20. __ __ This project had a written site-specific emergency plan.

21. __ __ This project had a site safety supervisor.

22. __ __ The site safety supervisor for this project was full-time.

23. __ __ This project had a written safety incentive program for hourly craft employees.

24. __ __ Toolbox safety meetings were required.

25. __ __ This project required prehire substance abuse testing of contractor employees.

26. __ __ Contractor employees were randomly screened for alcohol and drugs.

27. Substance abuse tests were conducted after an accident:

_____ Always ___ Sometimes ___ Seldom ____ Never ___ NA

28. Accidents were formally investigated:

_____ Always ___ Sometimes ___ Seldom ____ Never ___ NA

29. Near-misses were formally investigated:

_____ Always ___ Sometimes ___ Seldom ____ Never ___ NA

30. Senior management reviewed accidents:

_____ Always ____ Sometimes____ Seldom _____ Never ____ NA

31. Safety was a high priority topic at all pre-construction and construction meetings:

_____ Always _____ Sometimes _____ Seldom _____ Never

32. Safety records were a criterion for contractor/subcontractor selection:

_____ Always _____ Sometimes _____ Seldom _____ Never

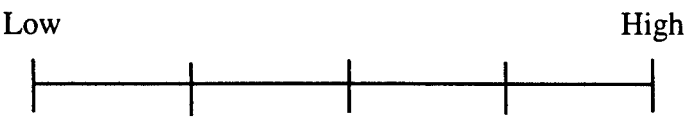
33. Pre-task planning for safety was conducted by contractor foremen:

_____ Always _____ Sometimes _____ Seldom _____ Never

34. Jobsite-specific orientation was conducted for new contractor and subcontractor employees:

_____ Always _____ Sometimes _____ Seldom _____ Never

35. Place a mark anywhere on the scale below that best describes the owner's commitment to safety on this project. Judge this owner's commitment relative to that of owners that you have experience with.



Team Building Practices

Team Building is a process that brings together a diverse group of project participants and seeks to resolve differences, remove roadblocks and proactively build and develop the group into an aligned, focused and motivated work team that strives for a common mission and for shared goals, objectives and priorities.

36. Was your company involved in a team building process that included owner personnel on this project?

Yes ___ No ___

If yes, answer questions 36a - 36h. If no, go to question 37.

	Yes	No	
36a.	___	___	Was an independent consultant used to facilitate the team building process?
36b.	___	___	Was a team-building retreat held early in the life of the project?

36c. ___ ___ Did this project have a documented team-building implementation plan?

36d. ___ ___ Were objectives of the team building process documented and clearly defined?

36e. Were team building meetings held among team members throughout the project?

_____ Regularly ___ Sometimes _____ Seldom _____Never

36f. Were follow-up sessions held to integrate new team members and reinforce concepts?

_____ Regularly ___ Sometimes _____ Seldom _____ Never

36g. Please indicate the project phases in which your company was involved in the team building process? (Check all that apply)

____ Pre-Project Planning
____ Design
____ Procurement
____ Construction
____ Startup

36h. Please indicate the parties involved in the team building process?

(Check all that apply)

____ Owner
____ Designer(s)
____ Contractor(s)
____ Other. If other, please specify
____ Major Suppliers
____ Subcontractor(s)
____ Construction Mgr.

C - Team Building Practice Use Index

Question	Yes	No	Score
36. Was a team building process used for this project?	1.00	0.00	1.00
36a. Was an independent consultant used to facilitate the team building process?	1.00	0.00	0.00
36b. Was a team-building retreat held early in the life of the project?	1.00	0.00	1.00
36c. Did this project have a documented team-building implementation plan?	100	0.00	0.00
36d. Were objectives of the team building process documented and clearly defined?	1.00	0.00	0.00

Question	Regularly	Some times	Seldom	Never	Score
36e. Were team building meetings held among team members throughout the project?	1.00	0.67	0.33	0.00	0.33
36f. Were follow-up sessions held to integrate new team members and reinforce concepts?	1.00	0.67	0.33	0.00	0.00

36g. Please indicate the project phases in which team building was used.					Score
Pre-Project Planning	**Design**	**Procurement**	**Construction**	**Startup**	
0.30	0.30	0.10	0.20	0.10	0.20

36h. Please indicate the parties involved in the team building process.							Score
Owner	**Designer**	**Contractors**	Major **Suppliers**	**Sub contractors**	**Constr. Mngr.**	**Other**	
0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.334

TOTAL	2.86
9 Questions, Maximum Score of 9 ⇒ Divide total by 0.9 to scale to 1-10 point range	
Team Building Practice Use Index	3.18

D - Safety Practice Use Index

Question		Yes	No	Score
19.	This project had a written site-specific safety plan.	1.00	0.00	1.00
20.	This project had a written site-specific emergency plan.	1.00	0.00	1.00
21.	This project had a site safety supervisor.	1.00	0.00	1.00
22.	The site safety supervisor for this project was full-time.	1.00	0.00	0.00
23.	This project had a written safety incentive program for hourly craft employees.	1.00	0.00	1.00
24.	Toolbox safety meetings were required.	1.00	0.00	1.00
25.	This project required prehire substance abuse testing of contractor employees.	1.00	0.00	1.00
26.	Contractor employees were randomly screened for alcohol and drugs.	1.00	0.00	0.00

Question		Always	Sometimes	Seldom	Never	NA	Score
27.	Substance abuse tests were conducted after an accident:	1.00	0.67	0.33	0.00	1.00	1.00
28.	Accidents were formally investigated:	1.00	0.67	0.33	0.00	1.00	0.67
29.	Near-misses were formally investigated:	1.00	0.67	0.33	0.00	1.00	0.33
30.	Senior management reviewed accidents:	1.00	0.67	0.33	0.00	1.00	0.67
31.	Safety was a high priority topic at all pre-construction and construction meetings:	1.00	0.67	0.33	0.00	1.00	1.00
32.	Safety records were a criterion for contractor/subcontractor selection:	1.00	0.67	0.33	0.00	1.00	0.00
33.	Pre-task planning for safety was conducted by contractor foremen:	1.00	0.67	0.33	0.00	1.00	1.00
34.	Jobsite-specific orientation was conducted for new contractor and subcontractor employees:	1.00	0.67	0.33	0.00	1.00	1.00
TOTAL							11.67
16 Questions, Maximum Score of 16 ⇒ Divide total by 1.6 to scale to 1-10 point range							
SAFETY PRACTICE USE INDEX							7.29

E – Project Data for Owners

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
O1	Yes	275953	19900000	0	0	0.0	0.0
O10	No	85423	21533000	0	0	0.0	0.0
O100	Yes	27630	17800000	0	0	0.0	0.0
O1000	Yes	82000	29000000	5	2	12.2	4.9
O101	Yes	145836	13800000	11	2	15.1	2.7
O102	Yes	1152930	119700000	31	0	5.4	0.0
O104	Yes	102100	9417000	1	0	2.0	0.0
O105	Yes	276710	36000000	3	0	2.2	0.0
O106	No	51000	6500000	1	0	3.9	0.0
O107	Yes	318000	29200000	1	0	0.6	0.0
O108	Yes	1850000	145496000	12	3	1.3	0.3
O109	Yes	43000	5800000	0	0	0.0	0.0
O11	No	189500	40197000	17	4	17.9	4.2
O110	Yes	133292	22400000	7	1	10.5	1.5
O111	Yes	579190	66230000	32	2	11.0	0.7
O112	No	174349	75005000	14	1	16.1	1.1
O115	Yes	550000	66400000	4	0	1.5	0.0
O116	Yes	455000	32819000	3	1	1.3	0.4
O117	Yes	196000	14900000	0	0	0.0	0.0
O118	Yes	27200	5510000	1	1	7.4	7.4
O119	No	40000	6282000	0	0	0.0	0.0
O12	Yes	63165	7720000	1	0	3.2	0.0
O120	Yes	60000	8415000	1	1	3.3	3.3
O121	Yes	72254	6955400	0	0	0.0	0.0
O122	No	47000	6475000	1	0	4.3	0.0
O123	Yes	120000	6500000	1	0	1.7	0.0
O124	Yes	1110000	132925000	57	6	10.3	1.1
O125	Yes	900000	54900000	34	4	7.6	0.9
O126	Yes	1000000	161000000	63	9	12.6	1.8
O127	Yes	100000	15399000	0	0	0.0	0.0
O128	No	250000	28600000	2	0	1.6	0.0
O129	No	542260	59300000	8	1	3.0	0.4
O13	Yes	63000	21900000	6	0	19.0	0.0
O130	Yes	29560	5891000	1	1	6.8	6.8
O132	Yes	49108	6671000	2	0	8.1	0.0
O133	Yes	297437	52900000	3	3	2.0	2.0
O135	No	375700	55400000	2	0	1.1	0.0
O136	Yes	521000	57200000	0	0	0.0	0.0
O137	Yes	112000	10845700	0	0	0.0	0.0
O139	Yes	500000	67600000	2	0	0.8	0.0
O140	Yes	194000	21500000	0	0	0.0	0.0
O142	Yes	50000	4812000	0	0	0.0	0.0
O143	Yes	500000	56640000	2	0	0.8	0.0
O149	Yes	30000	10968000	0	0	0.0	0.0

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
O150	Yes	73123	8323000	0	0	0.0	0.0
O151	Yes	80713	7949000	0	0	0.0	0.0
O152	Yes	27649	14000000	2	0	14.5	0.0
O153	Yes	103100	11572000	1	0	1.9	0.0
O154	Yes	24043	5400000	1	0	8.3	0.0
O155	Yes	1200000	144000000	5	2	0.8	0.3
O156	Yes	38830	23674000	0	0	0.0	0.0
O157	Yes	76000	22800000	0	0	0.0	0.0
O158	Yes	184000	25733000	0	0	0.0	0.0
O159	Yes	936093	82404000	23	2	4.9	0.4
O160	Yes	34980	8700000	0	0	0.0	0.0
O161	Yes	621000	72400000	10	0	3.2	0.0
O162	No	38000	6500000	0	0	0.0	0.0
O164	Yes	133366	9730000	0	0	0.0	0.0
O166	No	98850	12840000	0	0	0.0	0.0
O168	Yes	96000	13086000	2	0	4.2	0.0
O169	Yes	617300	104066000	13	0	4.2	0.0
O170	Yes	43100	12900000	0	0	0.0	0.0
O174	Yes	3348553	230951000	29	4	1.7	0.2
O175	Yes	81415	7094000	2	0	4.9	0.0
O176	No	581000	51422000	8	0	2.8	0.0
O178	No	98000	21500000	0	0	0.0	0.0
O179	Yes	148360	22770000	5	1	6.7	1.3
O188	Yes	660000	47230000	4	0	1.2	0.0
O189	No	45000	7975000	0	0	0.0	0.0
O19	No	69000	21500000	5	0	14.5	0.0
O2	Yes	275000	75132000	2	2	1.5	1.5
O20	Yes	25375	6440000	2	0	15.8	0.0
O21	Yes	27975	6413000	2	0	14.3	0.0
O22	Yes	1117000	124000000	21	1	3.8	0.2
O23	No	410000	48300000	5	0	2.4	0.0
O24	Yes	86000	13632000	1	0	2.3	0.0
O25	Yes	120000	10403000	1	0	1.7	0.0
O26	Yes	186000	22700000	6	1	6.5	1.1
O27	No	275818	44600000	8	1	5.8	0.7
O28	Yes	637000	70900000	38	9	11.9	2.8
O29	Yes	62800	5400000	0	0	0.0	0.0
O3	Yes	130000	15934000	0	0	0.0	0.0
O31	Yes	280000	43494067	4	3	2.9	2.1
O35	No	135000	14500000	6	1	8.9	1.5
O36	No	90000	15100000	4	0	8.9	0.0
O39	Yes	478774	104000000	52	15	21.7	6.3
O4	Yes	126000	16947000	0	0	0.0	0.0
O40	No	112000	29800000	0	0	0.0	0.0
O42	Yes	391409	28281000	4	0	2.0	0.0
O43	Yes	496000	39100000	14	0	5.6	0.0
O44	Yes	300000	95000000	6	4	4.0	2.7
O47	No	40887	12430000	2	2	9.8	9.8
O48	No	30791	9012000	0	0	0.0	0.0

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
O49	Yes	373661	106860000	16	43	8.6	23.0
O5	Yes	132815	11678000	2	2	3.0	3.0
O52	Yes	216113	12950000	4	1	3.7	0.9
O53	Yes	101000	12975000	0	0	0.0	0.0
O54	No	69451	9790000	2	0	5.8	0.0
O55	Yes	54190	8700000	0	0	0.0	0.0
O56	Yes	101044	14550000	1	0	2.0	0.0
O57	Yes	153590	19400000	3	1	3.9	1.3
O58	No	51720	5400000	0	0	0.0	0.0
O59	No	82000	14600800	3	0	7.3	0.0
O60	Yes	101357	8900000	2	0	3.9	0.0
O61	Yes	245000	27919787	2	0	1.6	0.0
O62	No	468508	131982000	9	1	3.8	0.4
O63	Yes	106400	14819000	0	0	0.0	0.0
O64	Yes	155862	10990000	1	1	1.3	1.3
O65	Yes	205000	29750000	1	0	1.0	0.0
O66	Yes	404593	32500000	1	0	0.5	0.0
O68	No	548000	82300000	18	2	6.6	0.7
O69	Yes	111398	21100000	2	0	3.6	0.0
O70	Yes	5000000	496950000	98	3	3.9	0.1
O72	Yes	240000	37900000	4	0	3.3	0.0
O73	Yes	298000	51700000	5	1	3.4	0.7
O74	Yes	67560	12520000	1	0	3.0	0.0
O75	Yes	2784268	207700000	32	1	2.3	0.1
O76	Yes	1093820	81380000	13	1	2.4	0.2
O77	Yes	914000	149300000	8	0	1.8	0.0
O78	Yes	87328	7360000	0	0	0.0	0.0
O79	Yes	320000	16722000	6	0	3.8	0.0
O8	Yes	148000	23000000	4	0	5.4	0.0
O80	Yes	160000	17400000	8	1	10.0	1.3
O81	Yes	148414	11500000	10	1	13.5	1.3
O82	Yes	367532	61000000	5	2	2.7	1.1
O83	No	128000	14500000	0	0	0.0	0.0
O84	No	300000	40925000	16	4	10.7	2.7
O85	Yes	1067000	155000000	22	9	4.1	1.7
O86	Yes	84680	13634000	2	0	4.7	0.0
O88	Yes	64200	7274000	1	0	3.1	0.0
O89	Yes	61168	5127000	0	0	0.0	0.0
O90	Yes	604900	65674000	8	0	2.6	0.0
O91	Yes	60000	9300000	1	1	3.3	3.3
O92	No	159968	9840000	3	0	3.8	0.0
O93	No	96344	11511000	1	0	2.1	0.0
O94	No	67066	8614000	0	0	0.0	0.0
O95	Yes	320000	32700000	6	0	3.8	0.0
O97	Yes	640300	70000000	6	0	1.9	0.0
O98	Yes	587000	54900000	6	0	2.0	0.0
O99	Yes	3595212	515000000	103	9	5.7	0.5

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
O1	Regularly	Sometimes	No	Yes	No	Never
O10	Regularly	Regularly	Yes	No	No	Never
O100	Regularly	Regularly	Yes	Yes	No	Sometimes
O1000	Regularly	Regularly	Yes	Yes	No	Regularly
O101	Regularly	Regularly	Yes	Yes	No	Sometimes
O102	Regularly	Regularly	Yes	Yes	No	Sometimes
O104	Regularly	Regularly	No	No	No	Regularly
O105	Regularly	Regularly	Yes	Yes	Yes	Regularly
O106	Regularly	Regularly	Yes	Yes	Yes	Regularly
O107	Regularly	Regularly	Yes	Yes	Yes	Regularly
O108	Regularly	Regularly	Yes	Yes	No	Sometimes
O109	Regularly	Regularly	Yes	Yes	Yes	NA
O11	Sometimes	Regularly	No	No	No	Never
O110	Regularly	Regularly	Yes	Yes	Yes	Seldom
O111	Sometimes	Sometimes	Yes	Yes	Yes	Regularly
O112	Sometimes	Regularly	No	No	Yes	Sometimes
O115	Regularly	Regularly	Yes	Yes	Yes	Regularly
O116	Regularly	Regularly	Yes	Yes	Yes	Regularly
O117	Regularly	Regularly	Yes	Yes	Yes	NA
O118	Sometimes	Regularly	No	No	No	Never
O119	Regularly	Regularly	No	No	No	NA
O12	Seldom	Regularly	No	Yes	Yes	Sometimes
O120	Regularly	Regularly	No	Yes	Yes	Sometimes
O121	Sometimes	Sometimes	No	No	No	NA
O122	Seldom	Sometimes	No	Yes	No	Regularly
O123	Regularly	Regularly	Yes	Yes	Yes	Regularly
O124	Seldom	Regularly	Yes	Yes	Yes	Regularly
O125	Never	Regularly	No	Yes	Yes	Regularly
O126	Sometimes	Regularly	Yes	Yes	Yes	Seldom
O127	Regularly	Regularly	No	Yes	Yes	Never
O128	Regularly	Regularly	No	No	No	Never
O129	Regularly	Regularly	No	No	No	Sometimes
O13	Regularly	Regularly	Yes	Yes	Yes	Regularly
O130	Regularly	Regularly	No	Yes	No	Regularly
O132	Regularly	Regularly	No	Yes	No	Seldom
O133	Sometimes	Regularly	No	Yes	Yes	Regularly
O135	Regularly	Regularly	No	Yes	No	Never
O136	Sometimes	Regularly	Yes	Yes	Yes	NA
O137	Sometimes	Regularly	Yes	Yes	Yes	NA
O139	Regularly	Regularly	NA	Yes	NA	Regularly
O140	Regularly	Regularly	No	Yes	Yes	Regularly
O142	Regularly	Regularly	No	Yes	Yes	NA
O143	Regularly	Regularly	Yes	Yes	Yes	Regularly
O149	Sometimes	Regularly	No	Yes	No	NA

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
O150	Regularly	Regularly	No	Yes	Yes	Regularly
O151	Regularly	Regularly	No	Yes	Yes	NA
O152	Never	Never	No	No	No	Never
O153	Regularly	Regularly	No	Yes	No	Never
O154	Regularly	Regularly	No	Yes	No	Never
O155	Regularly	Regularly	Yes	Yes	Yes	Regularly
O156	Regularly	Regularly	Yes	Yes	Yes	Regularly
O157	Regularly	Regularly	Yes	Yes	Yes	NA
O158	Regularly	Regularly	Yes	Yes	Yes	NA
O159	Sometimes	Regularly	Yes	Yes	No	Seldom
O160	Regularly	Regularly	Yes	Yes	No	Regularly
O161	Regularly	Regularly	No	Yes	No	Never
O162	Regularly	Regularly	Yes	Yes	Yes	NA
O164	Sometimes	Regularly	Yes	Yes	Yes	NA
O166	Sometimes	Regularly	No	Yes	No	Never
O168	Regularly	Regularly	No	Yes	No	Sometimes
O169	Regularly	Regularly	UNK	Yes	Yes	UNK
O170	Sometimes	Regularly	No	Yes	Yes	NA
O174	Regularly	Regularly	Yes	Yes	Yes	Regularly
O175	Regularly	Regularly	Yes	Yes	Yes	Regularly
O176	Regularly	Regularly	Yes	Yes	Yes	UNK
O178	Regularly	Regularly	Yes	Yes	No	Regularly
O179	Sometimes	Regularly	Yes	Yes	Yes	Sometimes
O188	Regularly	Regularly	Yes	Yes	Yes	Regularly
O189	Sometimes	Regularly	No	Yes	Yes	Regularly
O19	Regularly	Regularly	No	No	No	Never
O2	Regularly	Regularly	No	Yes	Yes	Sometimes
O20	Sometimes	Regularly	No	No	No	Never
O21	Regularly	Regularly	No	Yes	No	Never
O22	Regularly	Regularly	Yes	Yes	Yes	Regularly
O23	Regularly	Regularly	Yes	Yes	No	Regularly
O24	Sometimes	Regularly	Yes	Yes	Yes	Regularly
O25	Sometimes	Regularly	No	Yes	No	Never
O26	Regularly	Regularly	Yes	No	No	Never
O27	Regularly	Regularly	Yes	Yes	No	Never
O28	Regularly	Regularly	Yes	Yes	No	Never
O29	Sometimes	Seldom	No	No	Yes	NA
O3	Regularly	Regularly	Yes	Yes	Yes	NA
O31	Sometimes	Seldom	UNK	UNK	UNK	UNK
O35	Seldom	Regularly	No	Yes	No	Regularly
O36	Regularly	Regularly	No	Yes	Yes	Regularly
O39	Sometimes	Regularly	Yes	Yes	No	Never
O4	Regularly	Regularly	No	No	Yes	Never
O40	Regularly	Regularly	No	No	No	NA
O42	NR	Regularly	Yes	Yes	Yes	Regularly
O43	Regularly	Regularly	Yes	Yes	Yes	Regularly
O44	Sometimes	Regularly	No	Yes	Yes	Sometimes
O47	Regularly	Regularly	No	No	Yes	Regularly
O48	Regularly	Regularly	No	No	Yes	Regularly

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
O49	Regularly	Regularly	No	Yes	No	Regularly
O5	Regularly	Regularly	No	No	No	Never
O52	Regularly	Regularly	No	Yes	Yes	Sometimes
O53	Regularly	Regularly	No	Yes	Yes	NA
O54	Regularly	Regularly	Yes	Yes	No	Never
O55	Regularly	Regularly	Yes	Yes	Yes	NA
O56	Regularly	Regularly	Yes	Yes	UNK	Never
O57	Regularly	Regularly	No	Yes	Yes	Regularly
O58	Regularly	Regularly	Yes	Yes	Yes	NA
O59	Sometimes	Regularly	Yes	Yes	No	Sometimes
O60	Regularly	Regularly	Yes	Yes	No	NA
O61	Regularly	Regularly	Yes	Yes	Yes	NA
O62	Sometimes	Regularly	Yes	Yes	Yes	Sometimes
O63	Sometimes	Regularly	No	Yes	No	NA
O64	Sometimes	Regularly	No	Yes	No	Never
O65	Regularly	Regularly	No	Yes	Yes	NA
O66	Sometimes	Regularly	No	Yes	Yes	Regularly
O68	Sometimes	Regularly	No	Yes	Yes	Regularly
O69	Sometimes	Regularly	Yes	Yes	Yes	Regularly
O70	Regularly	Regularly	Yes	Yes	Yes	Regularly
O72	Sometimes	Regularly	No	Yes	Yes	Regularly
O73	Regularly	Regularly	No	Yes	Yes	Regularly
O74	Regularly	Regularly	Yes	Yes	Yes	Regularly
O75	Regularly	Regularly	Yes	Yes	Yes	Regularly
O76	Regularly	Regularly	Yes	Yes	Yes	Regularly
O77	Regularly	Regularly	Yes	Yes	Yes	Regularly
O78	Regularly	Regularly	No	Yes	Yes	NA
O79	Regularly	Regularly	Yes	Yes	Yes	Regularly
O8	Regularly	Regularly	Yes	No	No	Never
O80	Regularly	Regularly	Yes	Yes	No	Never
O81	Regularly	Regularly	No	Yes	Yes	NA
O82	Regularly	Regularly	Yes	No	No	Never
O83	Regularly	Regularly	No	No	No	Never
O84	Sometimes	Sometimes	No	No	No	Never
O85	Sometimes	Regularly	Yes	No	No	Never
O86	Regularly	Regularly	No	Yes	No	Never
O88	Regularly	Regularly	No	Yes	No	NA
O89	Regularly	Regularly	No	Yes	No	NA
O90	Regularly	Regularly	Yes	No	No	Sometimes
O91	Regularly	Regularly	No	Yes	Yes	Regularly
O92	Regularly	Regularly	Yes	Yes	Yes	NA
O93	Sometimes	Regularly	No	Yes	Yes	Sometimes
O94	Regularly	Regularly	Yes	Yes	Yes	NA
O95	Regularly	Regularly	No	Yes	Yes	Regularly
O97	Regularly	Regularly	Yes	Yes	Yes	Regularly
O98	Regularly	Regularly	Yes	Yes	No	Sometimes
O99	Regularly	Regularly	Yes	Yes	No	Sometimes

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
O1	Regularly	Never	Regularly
O10	Regularly	Regularly	Regularly
O100	Regularly	Regularly	Regularly
O1000	Sometimes	Seldom	Sometimes
O101	Regularly	Regularly	Regularly
O102	Regularly	Regularly	Regularly
O104	Regularly	Regularly	Regularly
O105	Regularly	Regularly	Regularly
O106	Regularly	Regularly	Regularly
O107	Regularly	Regularly	Regularly
O108	Regularly	Regularly	Regularly
O109	NA	Regularly	NA
O11	Regularly	Regularly	Regularly
O110	Regularly	Regularly	Regularly
O111	Regularly	Sometimes	Regularly
O112	Regularly	Sometimes	Regularly
O115	Regularly	Regularly	Regularly
O116	Regularly	Regularly	Regularly
O117	NA	NA	NA
O118	Regularly	Regularly	Regularly
O119	NA	Seldom	NA
O12	Regularly	Seldom	Regularly
O120	Regularly	Regularly	Regularly
O121	Sometimes	Sometimes	Sometimes
O122	Regularly	Sometimes	Seldom
O123	Regularly	Regularly	Regularly
O124	Regularly	Regularly	Seldom
O125	Regularly	Seldom	Never
O126	Regularly	Regularly	Regularly
O127	Regularly	Regularly	Regularly
O128	Regularly	NA	Regularly
O129	Regularly	Sometimes	Regularly
O13	Regularly	Regularly	Regularly
O130	Regularly	NA	Regularly
O132	Regularly	Regularly	Regularly
O133	Regularly	Regularly	Regularly
O135	Regularly	Regularly	Regularly
O136	NA	Sometimes	NA
O137	NA	Sometimes	NA
O139	Regularly	Regularly	Regularly
O140	Regularly	Regularly	Regularly
O142	NA	Regularly	NA
O143	Regularly	Sometimes	Regularly
O149	Regularly	Regularly	Regularly

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
O150	Regularly	Regularly	Regularly
O151	NA	NA	NA
O152	Never	Never	Never
O153	Regularly	Regularly	Seldom
O154	Regularly	Sometimes	Regularly
O155	Regularly	Sometimes	Regularly
O156	Regularly	Regularly	Sometimes
O157	NA	NA	NA
O158	NA	NA	NA
O159	Regularly	Never	Sometimes
O160	Regularly	Regularly	Regularly
O161	Regularly	Sometimes	Never
O162	NA	Regularly	NA
O164	Regularly	Seldom	Regularly
O166	Never	Never	Seldom
O168	Regularly	Regularly	Regularly
O169	Regularly	Regularly	Regularly
O170	NA	Regularly	NA
O174	Regularly	Regularly	Regularly
O175	Regularly	Sometimes	Regularly
O176	Regularly	Regularly	Regularly
O178	Regularly	Regularly	Regularly
O179	Regularly	Sometimes	Sometimes
O188	Regularly	Regularly	Regularly
O189	Regularly	Regularly	Sometimes
O19	Regularly	Never	Regularly
O2	Regularly	Regularly	Regularly
O20	Regularly	Regularly	Regularly
O21	Regularly	Sometimes	Regularly
O22	Regularly	Regularly	Sometimes
O23	Regularly	Regularly	Regularly
O24	Regularly	Regularly	Regularly
O25	Regularly	NA	Regularly
O26	Regularly	Sometimes	Regularly
O27	Regularly	Sometimes	Regularly
O28	Regularly	Sometimes	Regularly
O29	NA	NA	NA
O3	NA	Regularly	NA
O31	Regularly	Regularly	Seldom
O35	Regularly	Sometimes	Seldom
O36	Regularly	Regularly	Never
O39	Regularly	Regularly	Regularly
O4	Regularly	Sometimes	Regularly
O40	NA	NA	NA
O42	Regularly	NR	Regularly
O43	Regularly	Regularly	Regularly
O44	Regularly	Regularly	Sometimes
O47	Regularly	Sometimes	Regularly
O48	Regularly	Sometimes	Regularly

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
O49	Regularly	Regularly	Regularly
O5	Regularly	Never	Regularly
O52	Regularly	Regularly	Regularly
O53	NA	Regularly	NA
O54	Regularly	Regularly	Regularly
O55	Regularly	Regularly	Regularly
O56	Regularly	Regularly	Regularly
O57	Regularly	Regularly	Regularly
O58	NA	NA	NA
O59	Regularly	Sometimes	Regularly
O60	NA	Sometimes	NA
O61	NA	NA	NA
O62	Regularly	Sometimes	Regularly
O63	NA	NA	NA
O64	Regularly	Regularly	Regularly
O65	NA	NA	NA
O66	Regularly	Sometimes	Regularly
O68	Regularly	Sometimes	Seldom
O69	Sometimes	Sometimes	Regularly
O70	Regularly	Regularly	Regularly
O72	Regularly	Regularly	Regularly
O73	Regularly	Regularly	Regularly
O74	Regularly	Regularly	Regularly
O75	Regularly	Sometimes	Regularly
O76	Regularly	Sometimes	Regularly
O77	Regularly	Regularly	Regularly
O78	NA	NA	NA
O79	Regularly	Regularly	Sometimes
O8	Regularly	Regularly	Regularly
O80	Regularly	Regularly	Regularly
O81	Regularly	NA	Regularly
O82	Regularly	Regularly	Regularly
O83	Regularly	Regularly	Regularly
O84	Never	Never	Never
O85	Regularly	Regularly	Regularly
O86	Regularly	NA	Regularly
O88	NA	NA	NA
O89	NA	NA	NA
O90	Regularly	Sometimes	Regularly
O91	Regularly	Sometimes	Regularly
O92	NA	NA	NA
O93	Regularly	Sometimes	Regularly
O94	NA	Regularly	NA
O95	Regularly	Regularly	Regularly
O97	Regularly	Regularly	Regularly
O98	Regularly	Regularly	Regularly
O99	Regularly	Regularly	Regularly

F – Project Data for Contractors

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
C1	Yes	2333896	68842798	6	0	0.51	0
C10	Yes	362700	22200000	14	0	7.72	0
C100	No	671368	68525000	24	0	7.15	0
C1000	Yes	750000	118000000	11	4	2.93	1.07
C101	Yes	256000	8984000	4	0	3.13	0
C102	Yes	170794	17657000	2	0	2.34	0
C105	No	471000	44819000	38	12	16.14	5.1
C106	Yes	1799684	147130000	149	37	16.56	4.11
C107	No	562417	20937000	6	1	2.13	0.36
C108	Yes	1191000	124000000	43	0	7.22	0
C110	No	1022956	30571400	11	2	2.15	0.39
C111	No	72398	10988000	3	1	8.29	2.76
C112	Yes	540000	44500000	17	8	6.3	2.96
C113	No	1857054	141000000	91	17	9.8	1.83
C118	Yes	745560	63703000	12	9	3.22	2.41
C121	Yes	130000	25798000	2	0	3.08	0
C124	Yes	3253256	296947000	22	2	1.35	0.12
C125	No	461000	78321000	4	0	1.74	0
C126	No	90000	13119000	0	0	0	0
C127	No	447769	33273000	22	2	9.83	0.89
C128	Yes	2696728	200500000	54	5	4	0.37
C129	No	587000	52900000	21	8	7.16	2.73
C131	No	2925415	276536000	170	23	11.62	1.57
C137	Yes	1276399	95974000	7	0	1.1	0
C138	No	125000	17500000	0	0	0	0
C139	No	23500	5409000	0	0	0	0
C141	No	29694	1599000	0	0	0	0
C144	Yes	109913	8645823	3	0	5.46	0
C145	Yes	416500	58997000	5	2	2.4	0.96
C146	No	52000	4651263	0	0	0	0
C149	No	345885	30647000	32	5	18.5	2.89
C150	Yes	201722	8678000	5	0	4.96	0
C151	No	377000	28754000	11	3	5.84	1.59
C152	Yes	182718	17044000	4	0	4.38	0
C153	Yes	425000	37987000	14	1	6.59	0.47
C155	Yes	65000	14081000	0	0	0	0
C156	No	110000	10000000	8	0	14.55	0
C159	No	326000	26107000	4	0	2.45	0
C160	No	184000	14587000	1	0	1.09	0
C163	Yes	1282476	105400000	16	0	2.5	0
C169	Yes	1171000	57679000	7	0	1.2	0
C172	No	55820	12076000	0	0	0	0
C174	Yes	143744	6578000	2	0	2.78	0
C175	No	221824	7391000	4	1	3.61	0.9

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
C176	No	630000	61500000	1	0	0.32	0
C180	No	67450	4006000	0	0	0	0
C181	Yes	15656	698789	0	0	0	0
C182	Yes	15123	668071	0	0	0	0
C184	Yes	14450	7303000	0	0	0	0
C185	Yes	602000	28000000	14	0	4.65	0
C186	No	972217	28189239	18	1	3.7	0.21
C187	No	520200	53000000	4	0	1.54	0
C188	Yes	363000	54185983	7	1	3.86	0.55
C190	No	45500	5700000	0	0	0	0
C191	Yes	639600	117277000	5	0	1.56	0
C192	Yes	442800	41651000	2	0	0.9	0
C193	Yes	1745500	167600000	17	1	1.95	0.11
C195	Yes	475559	41692000	0	0	0	0
C2	Yes	320394	72971141	2	0	1.25	0
C20	No	190000	12500000	0	0	0	0
C21	No	946501	47543000	12	0	2.54	0
C214	Yes	1780000	156424000	3	0	0.34	0
C216	Yes	120000	32172000	0	0	0	0
C218	Yes	153308	11600000	5	0	6.52	0
C220	Yes	27000	4652000	0	0	0	0
C25	Yes	245340	4835000	5	0	4.08	0
C26	No	524615	5000000	8	1	3.05	0.38
C27	No	146284	6327000	2	1	2.73	1.37
C28	Yes	1950984	113684000	62	17	6.36	1.74
C29	Yes	374000	21500000	15	6	8.02	3.21
C3	Yes	129915	7600000	10	1	15.39	1.54
C30	Yes	330000	24230000	0	0	0	0
C31	Yes	46500	27300000	3	3	12.9	12.9
C32	Yes	75923	79400000	1	0	2.63	0
C34	Yes	890316	15258000	44	9	9.88	2.02
C41	No	767628	104057000	5	0	1.3	0
C42	Yes	483000	70800000	4	1	1.66	0.41
C44	Yes	206800	45042000	5	0	4.84	0
C51	Yes	1078365	57113000	20	0	3.71	0
C53	Yes	712000	62104000	4	0	1.12	0
C54	Yes	412546	35000000	4	0	1.94	0
C55	Yes	250000	6760000	12	3	9.6	2.4
C56	Yes	105790	15538000	5	0	9.45	0
C57	Yes	772138	70452000	4	1	1.04	0.26
C58	No	2103400	182500000	114	3	10.84	0.29
C59	No	2349000	181767000	23	3	1.96	0.26
C60	Yes	1512402	178100000	44	1	5.82	0.13
C61	Yes	1014000	74706000	10	0	1.97	0

CII #	TB used	Craft Workhours	Total Actual Project Cost	Recordable Injuries	Lost Workday Cases	RIR	LWCIR
C62	Yes	1016400	127757000	9	0	1.77	0
C63	Yes	554000	64729000	3	0	1.08	0
C64	Yes	2280000	160514000	22	0	1.93	0
C65	Yes	475559	41692000	0	0	0	0
C66	No	69836	6827000	0	0	0	0
C67	Yes	186530	21822000	2	0	2.14	0
C68	No	382000	37500000	3	1	1.57	0.52
C71	No	45362	2813000	0	0	0	0
C74	Yes	1452000	162095000	16	1	2.2	0.14
C75	Yes	234589	23559000	0	0	0	0
C76	Yes	396000	39549000	3	2	1.52	1.01
C79	No	645000	85149000	0	0	0	0
C8	No	515210	110014000	28	5	10.87	1.94
C83	No	35000	2693000	1	0	5.71	0
C86	Yes	40021	1544000	0	0	0	0
C87	Yes	66800	2802000	1	0	2.99	0
C88	Yes	35354	1372000	2	0	11.31	0
C89	No	146594	18077000	5	2	6.82	2.73
C91	No	66500	7593000	2	2	6.02	6.02
C92	No	1187531	73781000	45	1	7.58	0.17
C93	Yes	2279778	526206000	17	1	1.49	0.09
C94	No	496000	74970000	22	1	8.87	0.4
C95	Yes	1499000	116200000	20	0	2.67	0
C97	No	379344	53443000	5	2	2.64	1.05
C99	No	436850	36020000	48	8	21.98	3.66

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
C1	Regularly	Regularly	Yes	Yes	Yes	Regularly
C10	Regularly	Regularly	Yes	Yes	No	Regularly
C100	Sometimes	Regularly	Yes	Yes	No	Sometimes
C1000	Regularly	Regularly	Yes	Yes	No	Sometimes
C101	Sometimes	Regularly	No	Yes	No	Seldom
C102	Regularly	Regularly	No	Yes	No	Regularly
C105	Sometimes	Seldom	Yes	No	No	Never
C106	Sometimes	Regularly	Yes	Yes	No	Regularly
C107	Sometimes	Seldom	Yes	Yes	Yes	Sometimes
C108	Regularly	Regularly	Yes	Yes	Yes	Regularly
C110	Regularly	Regularly	Yes	Yes	Yes	Regularly
C111	Seldom	Seldom	No	Yes	No	Sometimes
C112	Sometimes	Sometimes	Yes	Yes	No	Never
C113	Regularly	Regularly	Yes	Yes	Yes	Regularly
C118	Sometimes	Regularly	Yes	Yes	No	Never
C121	Regularly	Regularly	Yes	Yes	Yes	Sometimes
C124	Regularly	Regularly	Yes	Yes	Yes	Regularly
C125	Regularly	Regularly	Yes	Yes	Yes	Regularly
C126	Regularly	Regularly	NA	Yes	NA	NA
C127	Regularly	Regularly	No	Yes	Yes	Regularly
C128	Regularly	Regularly	Yes	Yes	No	Regularly
C129	Sometimes	Regularly	Yes	No	No	Regularly
C131	Regularly	Regularly	Yes	Yes	Yes	Sometimes
C137		Regularly	Yes	Yes	Yes	Regularly
C138	Regularly	Regularly	No	Yes	Yes	Regularly
C139	Regularly	Regularly	No	No	No	Never
C141	Regularly	Regularly	Yes	Yes	Yes	NA
C144	Regularly	Regularly	No	Yes	Yes	Sometimes
C145	Regularly	Regularly	No	Yes	Yes	Regularly
C146	Seldom	Seldom	No	Yes	No	NA
C149	Sometimes	Regularly	No	Yes	Yes	Regularly
C150	Regularly	Regularly	No	Yes	Yes	Regularly
C151	Regularly	Regularly	Yes	Yes	Yes	Regularly
C152	Regularly	Regularly	No	Yes	Yes	Regularly
C153	Regularly	Regularly	Yes	Yes	Yes	Regularly
C155	Sometimes	Sometimes	No	No	No	NA
C156	Regularly	Regularly	Yes	Yes	No	Regularly
C159	Regularly	Regularly	Yes	Yes	Yes	Regularly
C160	Regularly	Regularly	Yes	Yes	Yes	Regularly
C163	Regularly	Regularly	Yes	Yes	Yes	Regularly
C169	Regularly	Regularly	Yes	Yes	Yes	Regularly
C172	Regularly	Regularly	No	Yes	Yes	NA
C174	Sometimes	Regularly	Yes	Yes	No	Regularly
C175	Regularly	Regularly	No	Yes	Yes	Regularly

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
C176	Regularly	Regularly	Yes	Yes	Yes	Regularly
C180	Regularly	Sometimes	No	No	No	NA
C181	Regularly	Regularly	No	Yes	Yes	NA
C182	Sometimes	Never	No	Yes	No	NA
C184	Regularly	Regularly	Yes	Yes	Yes	Regularly
C185	Regularly	Regularly	No	Yes	Yes	Regularly
C186	Regularly	Regularly	No	Yes	Yes	Regularly
C187	Regularly	Regularly	Yes	Yes	Yes	Regularly
C188	Regularly	Regularly	No	Yes	Yes	Unknown
C190	Sometimes	Regularly	Yes	Yes	No	Never
C191	Regularly	Regularly	Yes	Yes	Yes	Regularly
C192	Regularly	Regularly	Yes	Yes	Yes	Regularly
C193	Regularly	Regularly	Yes	Yes	Yes	Regularly
C195	Regularly	Regularly	Yes	Yes	Yes	NA
C2	Regularly	Regularly	Yes	Yes	Yes	Regularly
C20	Sometimes	Regularly	Yes	Yes	Yes	Regularly
C21	Sometimes	Regularly	No	Yes	Yes	Sometimes
C214	Regularly	Regularly	Yes	Yes	Yes	Regularly
C216	Regularly	Regularly	No	Yes	Yes	Regularly
C218	Sometimes	Regularly	Yes	Yes	Yes	Sometimes
C220	Regularly	Regularly	Yes	No	Yes	NA
C25	Regularly	Regularly	Yes	Yes	Yes	Sometimes
C26	Sometimes	Regularly	No	Yes	Yes	Regularly
C27	Regularly	Regularly	No	Yes	Yes	Sometimes
C28	Sometimes	Regularly	Yes	Yes	Yes	Regularly
C29	Seldom	Regularly	No	Yes	No	Sometimes
C3	Regularly	Regularly	Yes	Yes	Yes	Regularly
C30	Regularly	Regularly	Yes	Yes	No	NA
C31	Regularly	Sometimes	Yes	Yes	Yes	NA
C32	Regularly	Regularly	No	Yes	No	Regularly
C34	Sometimes	Regularly	Yes	Yes	Yes	Seldom
C41	Regularly	Regularly	Yes	Yes	Yes	Regularly
C42	Regularly	Regularly	Yes	Yes	Yes	Regularly
C44	Regularly	Regularly	Yes	Yes	Yes	Regularly
C51	Regularly	Regularly	No	Yes	Yes	Regularly
C53	Regularly	Regularly	No	Yes	Yes	Sometimes
C54	Sometimes	Regularly	Yes	Yes	Yes	Regularly
C55	Regularly	Regularly	No	No	No	Sometimes
C56	Sometimes	Regularly	No	Yes	Yes	Never
C57	Regularly	Regularly	Yes	Yes	Yes	Sometimes
C58	Regularly	Regularly	Yes	Yes	Yes	Regularly
C59	Sometimes	Regularly	Yes	Yes	Yes	NA
C60	Regularly	Regularly	Yes	Yes	Yes	Regularly
C61	Regularly	Regularly	No	Yes	Yes	Regularly

CII #	Pre-task planning	Orientation for new employees	Safety Incentives for Hourly Craft Employees	Pre-hire substance abuse testing	Random drug tests	Substance abuse tests after accidents
C62	Regularly	Regularly	Yes	Yes	Yes	Regularly
C63	Sometimes	Regularly	No	Yes	Yes	NA
C64	Regularly	Regularly	Yes	Yes	Yes	Regularly
C65	Regularly	Regularly	Yes	Yes	Yes	NA
C66	Regularly	Regularly	Yes	Yes	Yes	NA
C67	Regularly	Regularly	Yes	Yes	Yes	Regularly
C68	Regularly	Regularly	Yes	Yes	Yes	Regularly
C71	Regularly	Regularly	No	Yes	Yes	Sometimes
C74	Regularly	Regularly	Yes	Yes	Yes	Regularly
C75	Regularly	Regularly	Yes	Yes	Yes	Regularly
C76	Regularly	Regularly	Yes	Yes	Yes	Regularly
C79	Regularly	Regularly	Yes	No	No	NA
C8	Sometimes	Regularly	No	Yes	No	Regularly
C83	Regularly	Regularly	No	Yes	Yes	Sometimes
C86	Regularly	Regularly	No	No	No	NA
C87	Regularly	Regularly	Yes	Yes	No	Never
C88	Regularly	Regularly	Yes	Yes	No	Never
C89	Regularly	Regularly	Yes	No	No	Sometimes
C91	Sometimes	Regularly	No	Yes	No	Never
C92	Sometimes	Regularly	Yes	Yes	Yes	Regularly
C93	Regularly	Regularly	Yes	Yes	No	NR
C94	Sometimes	Regularly	Yes	Yes	No	Never
C95	Sometimes	Regularly	Yes	Yes	Yes	Regularly
C97	Regularly	Regularly	Yes	No	No	Never
C99	Seldom	Regularly	Yes	Yes	No	Never

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
C1	Regularly	Regularly	Regularly
C10	Regularly	Regularly	Regularly
C100	Regularly	Regularly	Regularly
C1000	Regularly	Sometimes	Sometimes
C101	Regularly	Regularly	Regularly
C102	Regularly	Regularly	Regularly
C105	Sometimes	Seldom	Sometimes
C106	Regularly	Sometimes	Sometimes
C107	Sometimes	Seldom	Regularly
C108	Regularly	Regularly	Regularly
C110	Regularly	Regularly	Regularly
C111	Regularly	Seldom	Regularly
C112	Regularly	Sometimes	Sometimes
C113	Regularly	Regularly	Regularly
C118	Regularly	Sometimes	Regularly
C121	Regularly	Regularly	Regularly
C124	Regularly	Sometimes	Regularly
C125	Regularly	Regularly	Regularly
C126	NA	Regularly	NA
C127	Regularly	Regularly	Regularly
C128	Regularly	Regularly	Regularly
C129	Regularly	Regularly	Sometimes
C131	Regularly	Sometimes	Sometimes
C137	Regularly	Regularly	Regularly
C138	Regularly	Sometimes	Regularly
C139	Regularly	Regularly	Regularly
C141	NA	NA	NA
C144	Regularly	Regularly	Regularly
C145	Regularly	Regularly	Regularly
C146	NA	NA	NA
C149	Regularly	Regularly	Sometimes
C150	Regularly	Regularly	Regularly
C151	Regularly	Regularly	Regularly
C152	Regularly	Regularly	Regularly
C153	Regularly	Regularly	Regularly
C155	Regularly	Regularly	Regularly
C156	Regularly	Regularly	Sometimes
C159	Regularly	Sometimes	Regularly
C160	Regularly	Sometimes	Regularly
C163	Regularly	Regularly	Regularly
C169	Regularly	Regularly	Regularly
C172	NA	Regularly	NA
C174	Regularly	Regularly	Regularly
C175	Regularly	Sometimes	Regularly

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
C176	Regularly	Regularly	Regularly
C180	NA	Sometimes	NA
C181	NA	Regularly	Sometimes
C182	NA	NA	NA
C184	Regularly	Regularly	Regularly
C185	Regularly	Regularly	Sometimes
C186	Regularly	Regularly	Regularly
C187	Regularly	Regularly	Regularly
C188	Regularly	Regularly	Regularly
C190	Regularly	Never	Never
C191	Regularly	Regularly	Regularly
C192	Regularly	Regularly	Regularly
C193	Regularly	Regularly	Regularly
C195	NA	Regularly	NA
C2	Regularly	Sometimes	Regularly
C20	Regularly	Regularly	Regularly
C21	Sometimes	Sometimes	Regularly
C214	Regularly	Regularly	Regularly
C216	Regularly	Regularly	Regularly
C218	Regularly	Regularly	Sometimes
C220	NA	NA	NA
C25	Regularly	Regularly	Regularly
C26	Sometimes	Sometimes	Sometimes
C27	Regularly	Regularly	Regularly
C28	Regularly	Sometimes	Sometimes
C29	Sometimes	Sometimes	Regularly
C3	Regularly	Sometimes	Regularly
C30	NA	Regularly	Regularly
C31	NA	NA	NA
C32	Regularly	Regularly	Regularly
C34	Sometimes	Sometimes	Sometimes
C41	Regularly	Regularly	Regularly
C42	Regularly	Sometimes	NA
C44	Regularly	Sometimes	Regularly
C51	Regularly	Regularly	Regularly
C53	Regularly	Regularly	Regularly
C54	Regularly	Regularly	Sometimes
C55	Regularly	Regularly	Regularly
C56	Regularly	Sometimes	Regularly
C57	Regularly	Sometimes	Regularly
C58	Regularly	Regularly	Regularly
C59	Regularly	Sometimes	Regularly
C60	Regularly	Regularly	Regularly
C61	Regularly	Regularly	Regularly

CII #	Accidents formally investigated	Near-misses formally investigated	Senior mgmt reviewed accidents
C62	Regularly	Regularly	Regularly
C63	NA	Sometimes	NA
C64	Regularly	Regularly	Regularly
C65	NA	Regularly	NA
C66	NA	Regularly	NA
C67	Regularly	Regularly	Regularly
C68	Regularly	Regularly	Regularly
C71	Regularly	Regularly	Regularly
C74	Regularly	Regularly	Regularly
C75	Regularly	Sometimes	Regularly
C76	Regularly	Regularly	Regularly
C79	NA	NA	NA
C8	Regularly	Regularly	Regularly
C83	Regularly	NA	Regularly
C86	NA	Regularly	NA
C87	Regularly	Sometimes	Regularly
C88	Regularly	Regularly	Regularly
C89	Regularly	Regularly	Regularly
C91	Regularly	Sometimes	Sometimes
C92	Regularly	Regularly	Sometimes
C93	Regularly	Regularly	Sometimes
C94	Regularly	Regularly	Regularly
C95	Regularly	Regularly	Regularly
C97	Regularly	Regularly	Sometimes
C99	Regularly	Sometimes	Regularly

G – Project Data for Owners Index Charts

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
O1	6.67	9.18	0.00	0.00
O10	7.50	0.00	0.00	0.00
O100	8.54	3.35	0.00	0.00
O101	9.17	3.35	15.09	2.70
O102	9.17	3.35	5.40	0.00
O103	9.79	0.00	2.13	NA
O104	8.13	3.12	1.96	0.00
O105	10.00	3.50	2.17	0.00
O106	10.00	0.00	3.92	0.00
O107	10.00	8.14	0.63	0.00
O108	9.17	7.88	1.30	0.32
O109	10.00	6.01	0.00	0.00
O11	6.04	0.00	17.90	4.20
O110	8.33	9.18	10.50	1.50
O111	9.18	7.47	11.05	0.69
O112	6.26	0.00	16.06	1.15
O113	8.88	6.30	NA	NA
O114	5.63	0.00	2.26	2.26
O115	10.00	5.46	1.45	0.00
O116	10.00	8.51	1.32	0.44
O117	10.00	5.76	0.00	0.00
O118	6.04	6.67	7.35	7.35
O119	5.83	0.00	0.00	0.00
O12	7.71	10.00	3.20	0.00
O121	6.26	3.99	0.00	0.00
O122	6.46	0.00	4.26	0.00
O123	9.38	4.97	1.67	0.00
O124	9.16	2.29	10.27	1.08
O125	8.13	4.92	7.56	0.89
O126	9.38	7.80	12.60	1.80
O127	8.75	3.96	0.00	0.00
O128	6.88	0.00	1.60	0.00
O129	7.09	0.00	2.95	0.37
O13	10.00	5.00	19.00	0.00
O130	7.50	1.75	6.77	6.77
O131	2.99	4.66	NA	NA
O132	7.71	6.25	8.15	0.00
O133	7.71	8.89	2.02	2.02
O134	7.08	0.00	NA	NA
O135	8.13	0.00	1.06	0.00
O136	8.96	6.09	0.00	0.00

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
O137	8.96	6.55	0.00	0.00
O138	8.54	5.30	NA	NA
O139	8.75	7.30	0.80	0.00
O14	8.54	7.50	UNK	UNK
O140	9.38	7.51	0.00	0.00
O141	6.04	0.00	NA	NA
O142	9.38	4.21	0.00	0.00
O143	9.79	8.84	0.80	0.00
O144	6.04	0.00	NA	NA
O145	6.67	8.79	NA	NA
O146	9.70	7.84	1.01	0.00
O147	9.79	8.09	2.76	0.46
O148	9.38	7.50	0.00	0.00
O149	7.68	3.55	0.00	0.00
O15	9.38	10.00	UNK	UNK
O150	9.38	3.26	0.00	0.00
O151	9.38	6.88	0.00	0.00
O152	2.29	9.59	14.47	0.00
O153	6.88	5.38	1.94	0.00
O154	7.29	5.72	8.32	0.00
O155	9.79	4.75	0.83	0.33
O156	9.17	7.47	0.00	0.00
O157	9.38	4.00	0.00	0.00
O158	9.38	4.43	0.00	0.00
O159	6.67	2.29	4.91	0.43
O16	9.33	10.00	UNK	UNK
O160	9.38	1.83	0.00	0.00
O161	7.29	5.04	3.22	0.00
O162	10.00	0.00	0.00	0.00
O163	9.38	0.00	NA	NA
O164	9.38	4.33	0.00	0.00
O165	5.84	0.00	NA	NA
O166	5.42	0.00	0.00	0.00
O167	6.88	5.59	NA	NA
O168	7.92	8.64	4.17	0.00
O169	8.84	9.79	4.21	0.00
O170	7.29	7.39	0.00	0.00
O175	9.79	6.79	4.91	0.00
O176	9.80	0.00	2.75	0.00

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
O177	10.00	7.67	NA	NA
O178	9.38	0.00	0.00	0.00
O179	7.93	4.04	6.74	1.35
O180	6.88	0.00	NA	NA
O181	9.17	0.00	NA	NA
O182	6.46	0.00	NA	NA
O183	9.35	8.79	NA	NA
O184	9.38	7.34	NA	NA
O185	7.47	9.00	NA	NA
O186	4.86	6.92	NA	NA
O187	7.47	9.00	NA	NA
O188	10.00	8.55	1.21	0.00
O189	8.96	0.00	0.00	0.00
O19	5.63	0.00	14.50	0.00
O190	6.46	0.00	NA	NA
O191	7.29	8.59	NA	NA
O192	7.09	7.76	NA	NA
O193	6.46	0.00	NA	NA
O194	8.33	9.79	NA	NA
O195	8.25	0.00	NA	NA
O196	7.50	6.25	NA	0.00
O2	7.92	9.18	1.50	1.50
O20	6.46	7.50	15.80	0.00
O21	6.04	5.00	14.30	0.00
O22	9.79	9.18	3.80	0.20
O23	9.38	0.00	2.40	0.00
O24	9.79	5.00	2.30	0.00
O25	7.78	5.83	1.70	0.00
O26	7.92	7.50	6.50	1.10
O27	7.92	0.00	5.80	0.70
O28	8.54	7.50	11.90	2.80
O29	5.83	9.18	0.00	0.00
O3	9.75	7.50	0.00	0.00
O30	9.75	0.00	UNK	UNK
O31	7.57	7.50	2.90	2.10
O32	5.63	4.18	UNK	UNK
O33	8.00	0.00	UNK	UNK
O35	6.88	0.00	8.90	1.50
O36	8.54	0.00	8.90	0.00

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
O37	6.39	0.00	UNK	UNK
O38	9.38	5.00	1.60	UNK
O39	8.54	5.00	21.70	6.30
O4	7.50	5.83	0.00	0.00
O40	7.50	0.00	0.00	0.00
O41	7.29	5.00	UNK	UNK
O42	10.00	9.18	2.00	0.00
O43	10.00	10.00	5.60	0.00
O44	7.30	6.68	4.00	2.70
O45	5.93	8.35	UNK	UNK
O47	7.29	0.00	9.80	9.80
O48	7.29	0.00	0.00	0.00
O49	8.13	6.68	8.60	23.00
O5	6.88	10.00	3.00	3.00
O50	7.92	0.00	UNK	UNK
O51	7.92	0.00	UNK	UNK
O52	7.71	4.18	3.70	0.90
O53	9.23	7.50	0.00	0.00
O54	8.75	0.00	5.80	0.00
O55	10.00	7.50	0.00	0.00
O56	8.67	7.50	2.00	0.00
O57	9.38	3.35	3.90	1.30
O58	9.17	0.00	0.00	0.00
O59	8.13	0.00	7.30	0.00
O60	8.21	5.00	3.90	0.00
O61	9.17	5.00	1.60	0.00
O62	8.76	0.00	3.80	0.40
O63	5.56	3.33	0.00	0.00
O64	7.29	5.00	1.30	1.30
O65	7.50	5.83	1.00	0.00
O66	8.76	4.18	0.50	0.00
O68	8.13	0.00	6.60	0.70
O69	8.76	7.50	3.60	0.00
O70	10.00	10.00	3.90	0.10
O71	9.11	4.18	UNK	UNK
O72	9.17	8.35	3.30	0.00
O73	9.38	10.00	3.40	0.70
O74	10.00	8.35	3.00	0.00
O75	9.79	10.00	2.30	0.10

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
O76	9.79	10.00	2.40	0.20
O77	10.00	10.00	1.80	0.00
O78	9.17	7.50	0.00	0.00
O79	9.79	6.68	3.80	0.00
O8	6.46	5.00	5.40	0.00
O80	8.75	9.18	10.00	1.30
O81	9.29	7.50	13.50	1.30
O82	8.13	6.68	2.70	1.10
O83	7.50	0.00	0.00	0.00
O84	4.38	0.00	10.70	2.70
O85	7.92	5.83	4.10	1.70
O86	7.33	7.50	4.70	0.00
O87	3.06	0.00	UNK	UNK
O88	7.50	10.00	3.10	0.00
O89	7.50	10.00	0.00	0.00
O90	8.34	10.00	2.60	0.00
O91	8.54	4.18	3.30	3.30
O92	10.00	0.00	3.80	0.00
O93	7.51	0.00	2.10	0.00
O94	10.00	0.00	0.00	0.00
O95	8.75	7.50	3.80	0.00
O96	9.79	0.00	UNK	UNK
O97	10.00	7.50	1.90	0.00
O98	9.17	3.35	2.00	0.00
O99	8.54	4.18	5.70	0.50

H – Project Data for Contractors Index Charts

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
C1	10	4.15	1.00	0.00
C10	9.375	5.85	8.00	0.00
C100	8.75625	0	7.00	0.00
C101	7.5	5	3.00	0.00
C102	8.3375	6.65	2.00	0.00
C103	7.50625	0	78.00	0.00
C104	8.125	7.5	-888.00	-888.00
C105	5.41875	0	16.00	5.00
C106	8.55	9.175	17.00	4.00
C107	6.875	0	2.00	0.00
C108	9.79375	8.35	7.00	0.00
C109	10	2.5	4.00	0.00
C11	9.5875	0	11.00	2.00
C110	10	0	2.00	0.00
C111	4.7875	0	8.00	3.00
C112	7.71875	5	6.00	3.00
C113	10	0	10.00	2.00
C114	6.25	7.5	11.00	11.00
C115	6.45625	5	50.00	0.00
C116	8.75	10	13.00	9.00
C117	6.04375	0	42.00	6.00
C118	7.7125	9.175	3.00	2.00
C119	9.79375	5	16.00	2.00
C12	8.3375	0	11.00	2.00
C121	9.79375	6.675	3.00	0.00
C123	10	5	12.00	2.00
C124	9.79375	6.675	1.00	0.00
C125	10	0	2.00	0.00
C126	8.18182	0	0.00	0.00
C127	8.54	0.00	9.83	0.89
C128	9.38	9.42	4.00	0.37
C129	8.34	0.00	7.16	2.73
C13	7.91875	0	9.00	4.00
C130	7.92	0.00	4.83	0.00
C131	9.18	0.00	11.62	1.57
C132	8.61	0.00	NA	NA
C133	8.61	0.00	NA	NA
C134	8.61	0.00	NA	NA
C135	7.92	2.17	0.26	0.13

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
C136	8.61	0.00	NA	NA
C137	10.00	8.26	1.10	0.00
C138	8.54	0.00	0.00	0.00
C139	6.88	0.00	0.00	0.00
C140	8.61	7.68	NA	NA
C141	9.14	0.00	0.00	0.00
C142	8.61	0.00	NA	NA
C143	6.88	0.00	8.00	4.00
C144	9.17	4.42	5.46	0.00
C145	9.38	7.18	2.40	0.96
C146	6.66	0.00	0.00	0.00
C147	10.00	9.79	2.76	NA
C148	10.00	8.13	2.53	0.16
C149	8.76	0.00	18.50	2.89
C150	9.38	4.84	4.96	0.00
C151	10.00	0.00	5.84	1.59
C152	9.38	6.89	4.38	0.00
C153	10.00	6.68	6.59	0.47
C154	8.61	4.25	NA	NA
C155	6.26	0.67	0.00	0.00
C156	9.17	0.00	14.55	0.00
C157	10.00	5.54	1.00	0.00
C158	8.61	8.55	NA	NA
C159	9.79	0.00	2.45	0.00
C160	9.79	0.00	1.09	0.00
C161	8.61	4.75	NA	NA
C162	8.75	2.25	0.92	0.00
C163	10.00	3.45	2.50	0.00
C164	8.61	1.62	NA	NA
C165	8.61	0.00	NA	NA
C166	9.58	5.92	4.25	0.00
C167	8.61	0.00	NA	NA
C168	8.61	4.09	NA	NA
C170	8.61	5.96	NA	NA
C171	8.61	3.67	NA	NA
C172	9.38	7.01	0.00	0.00
C173	8.61	9.46	NA	NA
C174	8.96	3.38	2.78	0.00
C175	9.17	0.00	3.61	0.90

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
C176	10.00	0.00	0.32	0.00
C177	8.13	0.00	NA	NA
C178	9.38	0.00	NA	NA
C179	9.38	0.00	NA	NA
C180	6.46	0.00	0.00	0.00
C181	9.17	5.75	0.00	0.00
C182	7.29	4.29	0.00	0.00
C183	8.13	7.13	5.19	0.86
C185	9.17	8.30	4.65	0.00
C186	9.38	0.00	3.70	0.21
C187	9.79	0.00	1.54	0.00
C188	9.18	3.59	3.86	0.55
C189	7.92	6.70	22.04	1.60
C190	6.67	0.00	0.00	0.00
C191	10.00	8.84	1.56	0.00
C192	10.00	8.76	0.90	0.00
C193	10.00	10.21	1.95	0.11
C194	8.61	8.01	NA	NA
C195	10.00	9.67	0.00	0.00
C196	8.61	0.00	NA	NA
C197	8.61	0.00	NA	NA
C198	8.61	2.88	NA	NA
C199	8.61	8.01	NA	NA
C2	9.79375	10	1.00	0.00
C20	9.79375	0	0.00	0.00
C200	10.00	9.17	2.68	0.38
C205	7.71	3.55	1.80	0.12
C206	8.13	4.55	NA	0.08
C207	8.13	4.55	NA	0.22
C208	8.75	7.92	NA	0.27
C209	8.13	4.59	0.29	0.20
C21	8.55	0	3.00	0.00
C210	8.13	4.59	0.24	0.00
C211	8.75	4.64	NA	0.00
C212	8.61	6.84	NA	NA
C213	8.61	3.84	NA	NA
C214	10.00	9.42	0.34	0.00
C215	8.61	8.25	NA	NA
C216	9.38	5.21	0.00	0.00

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
C217	7.50	0.00	0.85	0.09
C218	9.38	4.14	6.52	0.00
C219	7.71	0.00	NA	NA
C220	8.54	6.96	0.00	0.00
C24	6.88125	9.175	13.00	3.00
C25	9.5875	4.175	4.00	0.00
C26	8.55	0	3.00	0.00
C27	8.9625	0	3.00	1.00
C28	8.75625	10	6.00	2.00
C29	7.7125	6.675	8.00	3.00
C3	7.91875	2.5	15.00	2.00
C30	9.28571	7.5	0.00	0.00
C31	8.61667	7.5	13.00	13.00
C32	8.125	5	3.00	0.00
C33	7.71875	0	18.00	6.00
C34	8.34375	6.675	10.00	2.00
C4	7.5	0	6.00	2.00
C41	10	0	1.00	0.00
C42	9.78	5	2.00	0.00
C44	9.78	5.825	5.00	0.00
C45	8.3375	9.175	11.00	1.00
C46	7.3	10	7.00	2.00
C47	8.75625	0	15.00	2.00
C48	9.78	5	13.00	8.00
C49	6.66875	8.35	14.00	8.00
C5	6.88125	0	4.00	0.00
C50	9.16875	0	-888.00	-888.00
C51	9.375	10	4.00	0.00
C52	7.50625	8.35	5.00	1.00
C53	9.16875	5	1.00	0.00
C54	9.5875	6.675	2.00	0.00
C55	7.29375	4.15	10.00	2.00
C56	7.7125	3.325	9.00	0.00
C57	9.5875	8.325	1.00	0.00
C58	10	0	11.00	0.00
C59	9.56	0	2.00	0.00
C6	10	10	3.00	0.00
C60	10	7.5	6.00	0.00
C61	9.375	4.15	2.00	0.00

CII_ID	SFTINDEX	TMBINDEX	RIR	LWCIR
C62	10	10	2.00	0.00
C63	8.72308	9.175	1.00	0.00
C64	10	10	2.00	0.00
C65	10	7.5	0.00	0.00
C66	10	0	0.00	0.00
C67	10	2.5	2.00	0.00
C68	10	0	2.00	1.00
C69	7.7125	0	-888.00	0.00
C70	5.63125	0	9.00	0.00
C71	8.3375	0	0.00	0.00
C72	6.4625	0	2.00	0.00
C73	5.63125	0	11.00	0.00
C74	10	5	2.00	0.00
C75	9.79375	4.175	0.00	0.00
C76	10	4.175	2.00	1.00
C79	8.33333	0	0.00	0.00
C8	8.54375	0	11.00	2.00
C80	9.79375	7.5	-888.00	-888.00
C83	9.11333	0	6.00	0.00
C86	6.92308	2.5	0.00	0.00
C87	7.91875	2.5	3.00	0.00
C88	8.125	7.5	11.00	0.00
C89	8.54375	0	7.00	3.00
C9	9.79375	9.175	6.00	1.00
C90	4.71667	1.65	0.00	0.00
C91	6.05	0	6.00	6.00
C92	9.5875	0	8.00	0.00
C93	9.11333	8.35	1.00	0.00
C94	8.54375	0	9.00	0.00
C95	9.79375	9.175	3.00	0.00
C97	7.91875	0	3.00	1.00
C98	7.10667	0	-888.00	-888.00
C99	7.29375	0	22.00	4.00

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Vita

Marshall Troutman Sykes was born on September 1, 1962 in Albuquerque, New Mexico. He grew up in Albuquerque, San Antonio, Texas, Columbia, South Carolina, and Pinebluff, North Carolina. He graduated from Pinecrest High School in Southern Pines, NC in 1980. He graduated from N.C. State University in 1984 and 1986 with a Bachelor of Science Degree in Materials Engineering and a Master of Science Degree in Materials Engineering, respectively. He has one publication which is "Erosion of SiC-Reinforced Alumina Ceramic Composites", Composites vol. 18 no. 2, April 1987. He was commissioned as an Ensign in the Civil Engineer Corps of the United States Navy in 1988. He was promoted to Lieutenant on July 1, 1992. His tours of duty include Marine Corps Air Station Cherry Pt, Naval Mobile Construction Battalion THREE, and Naval Air Station Sigonella.

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